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By C. P. Burgess

SCIENCE AND GOLF

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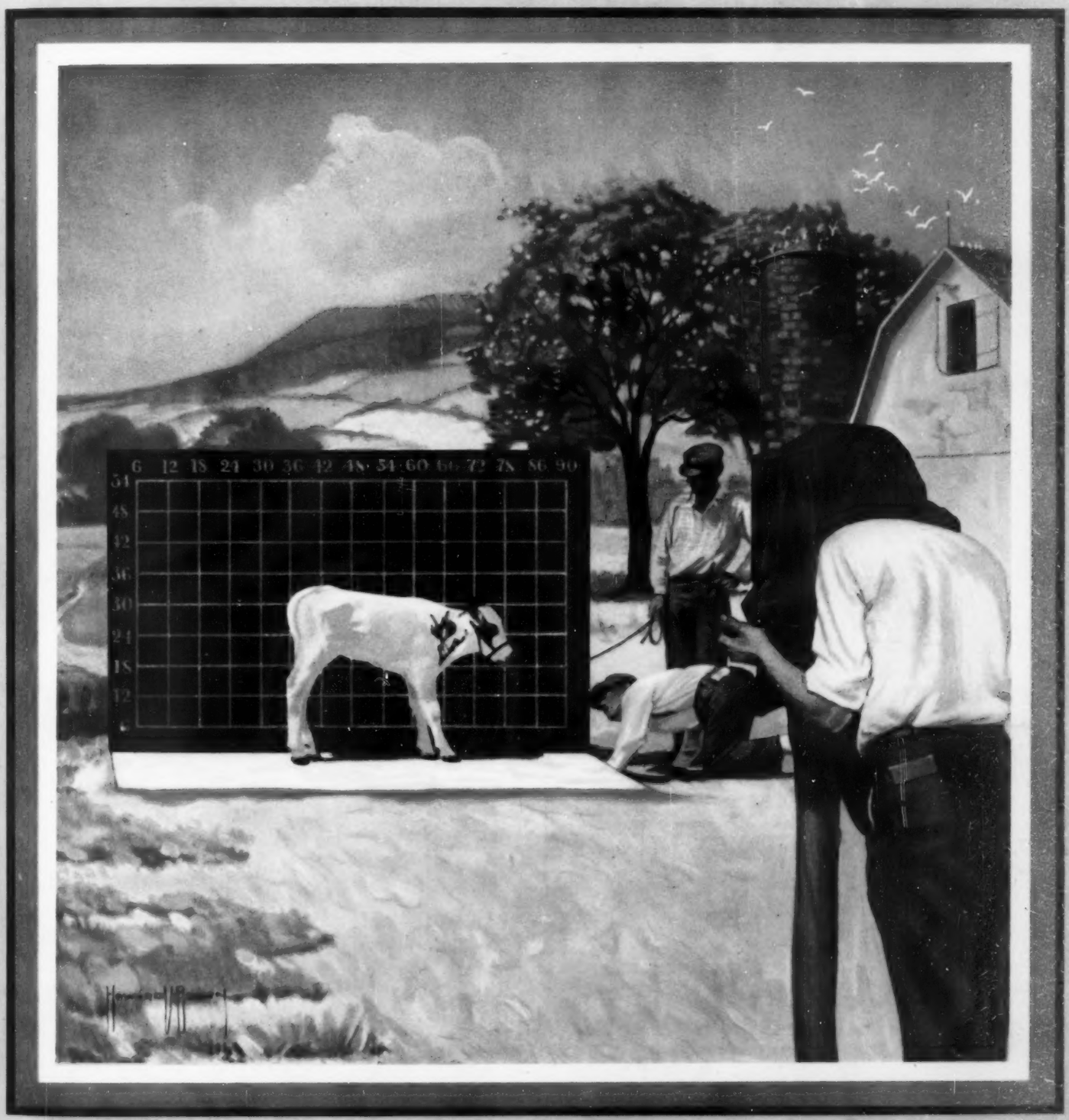

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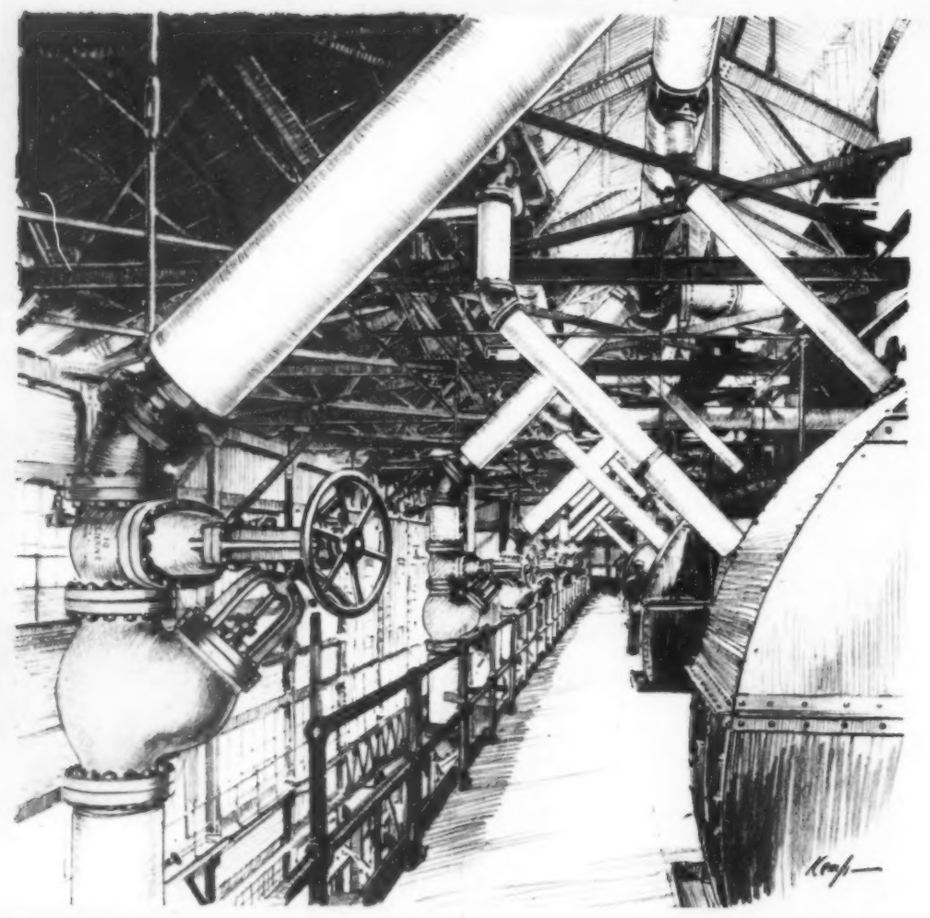

Carnegie Steel Co. chooses Crane cast steel

Historians, marking man's progress by his use of metals, call this "the age of steel." The story of its utilization, from the days of the Toledo sword-blade to our sky-scrapers and ships and mighty river spans, is a romantic epic of advancing knowledge. Today, the high tribute to any material or product is to say that it is as strong as steel.

Among the pioneers in this country to produce cast steel valves and fittings was the Crane Co. With characteristic thoroughness, the best methods of manufacture have been carefully evolved. To enable the exact control of temperature which Crane deems essential, only electric furnaces are used. Every step in the production process is paced by chemical analysis. The molds of very refractory sand are baked; and the flasks are extra deep to allow generous risers, insuring tight, solid castings. Finally, correct annealing and slow cooling relieve internal strains and give fine, even grain.

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A Crane shower, with volume regulator to meet variations in water pressure.

Above: a view in the Carrie boiler house of the Carnegie Steel Co., Rankin, Pennsylvania, showing boiler leads and main steam header. The valves and fittings are of extra heavy Crane electric cast steel. B. Floersheim & Co., Pittsburgh, were the piping contractors.

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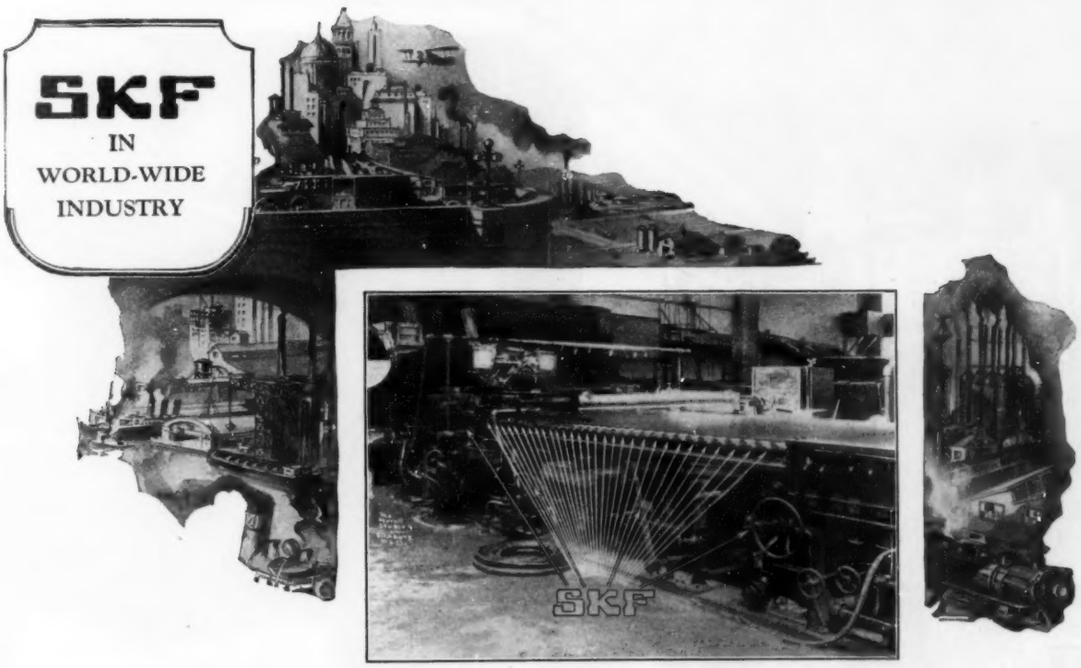

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76 Internationals in the Union Ice Company Fleet

Following is a letter from the Union Ice Company:

"Our company has in operation seventy-six International Trucks. Two at our Reno plant are now finishing their seventh year of service. We have a fleet of Internationals operating in our San Francisco delivery, where, due to hills and cobble pavement, the requirements on motor vehicles in heavy-duty service are most exacting.

"We are well satisfied with the performance of these trucks and are pleased to acknowledge the satisfactory service which the Harvester Company is rendering from its various branches."

(Signed)
UNION ICE COMPANY
M. H. Robbins, President and Gen. Mgr.

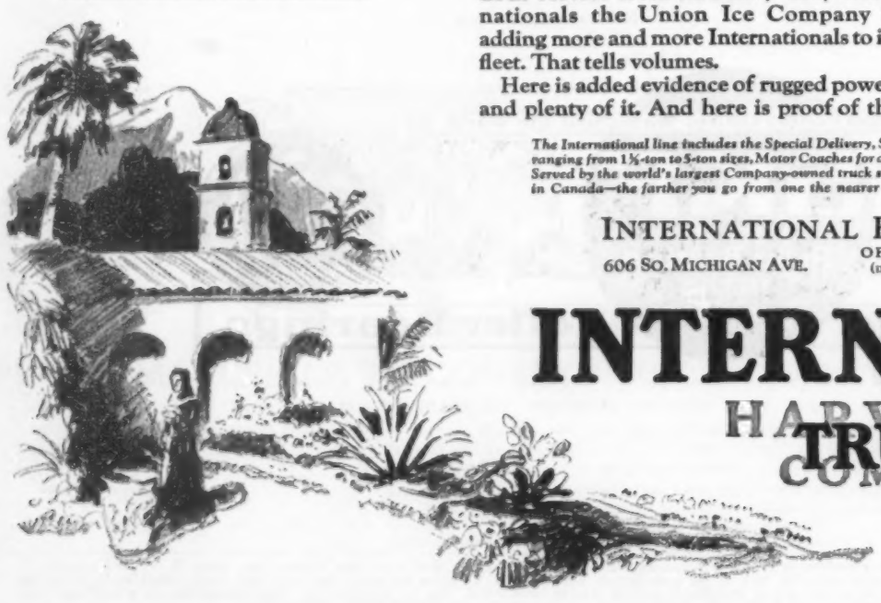
Ice Delivery in Sunny California

UP THE steep hills of San Francisco with heavy loads of ice! Hammering over the rough cobbled streets that try the fibre of men and trucks!

Seventy-six International Trucks serve the Union Ice Company whose plants and trucks are scattered all over California and Nevada. After seven years of the most strenuous service from its heavy-duty Internationals the Union Ice Company is adding more and more Internationals to its fleet. That tells volumes.

Here is added evidence of rugged power, and plenty of it. And here is proof of the *climbing ability* of International Trucks. Thousands of other owners use that ability on hills. Others use it to haul rock and earth out of excavations. Others to pull loads through hub-deep mud of oil fields or to bring timber out of the forest.

Many are the stories told, by owners and drivers, of the climbing ability of their Internationals. Yet power alone does not account for the success of International Trucks. Power is backed by all the other qualities that the Harvester organization has learned to put into trucks through more than 22 years of truck building.



The International line includes the Special Delivery, Speed Trucks of 1½-ton and 1½-ton sizes, Heavy-Duty Trucks ranging from 1½-ton to 5-ton sizes, Motor Coaches for all requirements, and the McCormick-Deering Industrial Tractor. Served by the world's largest Company-owned truck service organization—121 branches in the United States and 17 in Canada—the farther you go from one the nearer you get to another. Write for complete descriptive literature.

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SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, DECEMBER, 1926 — *Edited by* ORSON D. MUNN — EIGHTY-SECOND YEAR

CHEMISTRY

BELIEVING that there is no field in industrial effort today more fraught with possibilities than chemistry—more particularly industrial chemistry—it is with much satisfaction we announce that beginning with our January issue, D. H. Killiffer, Secretary of the American Chemical Society, who is intimately in contact with all that transpires in this field, becomes a regular contributor to the Scientific American. He will have a department in which will be noted each month the latest announcements and facts of interest upon which authoritative comments will be made.

THEORIES

WE receive about a dozen theories a day from people all over the world. Theories of this, theories of that, theories of everything from a sub-electron to a hyper-super-universe. They arrive, generally, in the form of an elaborately prepared manuscript on which someone has put literally hundreds of hours of thought and preparation, most of which is wasted.

Our readers do not see these theories for few if any of them come to us supported by actual laboratory test. The ancient Greeks attempted to reach truth by reasoning alone but they went far astray. Modern science says, "Ask Nature by making an experiment." This, few of these theorists seem to find necessary.

When, however, a theory has run the gauntlet of the various scientific societies which are made up of professional scientific men, and has at least received considerable notice—even if not acceptance—*then* we often publish a résumé of it, accompanied by a frank statement concerning its present status.

BAIT

WHAT bait would you use to catch a mountain lion?

Catnip!

The Biological Survey is using it. According to Dr. A. K. Fisher of the Economic Investigation Division of the Survey, catnip has a peculiar lure for all members of the cat tribe, except the cheetah of India. One drop of oil is diluted with 20 drops of petroleum, the dilution, as in the case of attar of roses and other perfumes, increasing the odor. A drug firm in New York has been urged to produce catnip oil not only for the Survey but for private individuals who desire to trap wild animals.

It only goes to show that domestic felines are no more distant from their wild cousins than we civilized humans are from ours.

In This Issue

Germs That Carry Lamps

Fireflies, glow worms, luminous fishes and other animals produce their own lights. Even some bacteria do it and they do it more efficiently than man does it with his electric lamps. New research has thrown more light on these tiny torch bearers. The story is told on page 414.

Planning Still Larger Airships

Government technical bureaus have designed two giant airships for the Navy, twice as large as the *Los Angeles*, and with a radically new design—short, fat and "buxom." They will be filled with helium, armed to the teeth and much stronger than the ill-fated *Shenandoah*. On page 418 a government authority explains the new plans of our Navy.

Not a "Death Ray"

A remarkable new cathode-ray tube which kills small animals has just been announced in the press. Already many erroneous and even ridiculous statements have been made about it. On page 420 you will find a thoroughly accurate, authentic account of this marvel, with the sensational nonsense left out.

Golf Controversy!

When golf fans fall into an argument the rest of us stand back and watch the fun as the fur flies. That is what has happened in the columns of the Scientific American. In our August issue Professor H. H. Sheldon said one thing—now a golf ballistician says another. Turn to page 426.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 478.

For Next Month

Brains

Nobody knows yet how we think; there are only *theories*. But we are rapidly learning more and more about the development of that marvelous organ called the brain. Next month Professor G. Elliot Smith of the University of London, famous anatomist and authority on human evolution, will contribute an article, revealing new knowledge concerning the brain.

What Tires a Tire?

Largely heat—the heat generated when the tire bends at each turn of the wheel. This heat gradually overcures the tire and it becomes decrepit. New ways are being sought—and found—to overcome this. Next month D. H. Killifer, well-known chemist, will explain them.

Telepathy, Mind-Reading: Fake?

Sometimes, at least, it is. When demonstrated on the stage it is quite certain to be faked. How the professional mind-readers that circulate among the audience and read their minds actually signal to their confederates on the stage forms the nucleus of a brilliant account by Dr. Walter Franklin Prince, Research Officer of the Boston Society for Psychic Research.

Other articles on Fossils in Illinois; Inventors Who Have Made Good Commercially; Children of the Sun; How the Bullet Identifies the Criminal; Wheels Made from Steel I-beams; Unit Automobile Bodies; The Rising Tide of Insects; Astronomy; Radio.

MORE THAN 200 PICTURES

¶ **Do you like facts? Not half truths, not exaggerations, but the statements by the authorities about what the world's thinkers are accomplishing? There is one way to get them—send $4 for a year's subscription to the Scientific American.**

EVOLUTION

WE told you so!

We predicted that the Tennessee evolution trial would boom evolution among the masses. It has. Read this, from the New York *Times:* "Frank Cummings went to jail again yesterday for stealing a book. It was Darwin's 'Origin of Species.' He told the magistrate his interest in evolution dated from the 'Monkey Trial' in Tennessee."

Until that famous event warmed up the cooling evolution controversy it is safe to say that Cummings did not know what evolution meant. And now he is in jail for his zeal concerning it! We hope he will there be given the full opportunity to read "The Origin of Species." To be frank, we have read more lively works on evolution. Perhaps, though, if we were sent to jail.....!

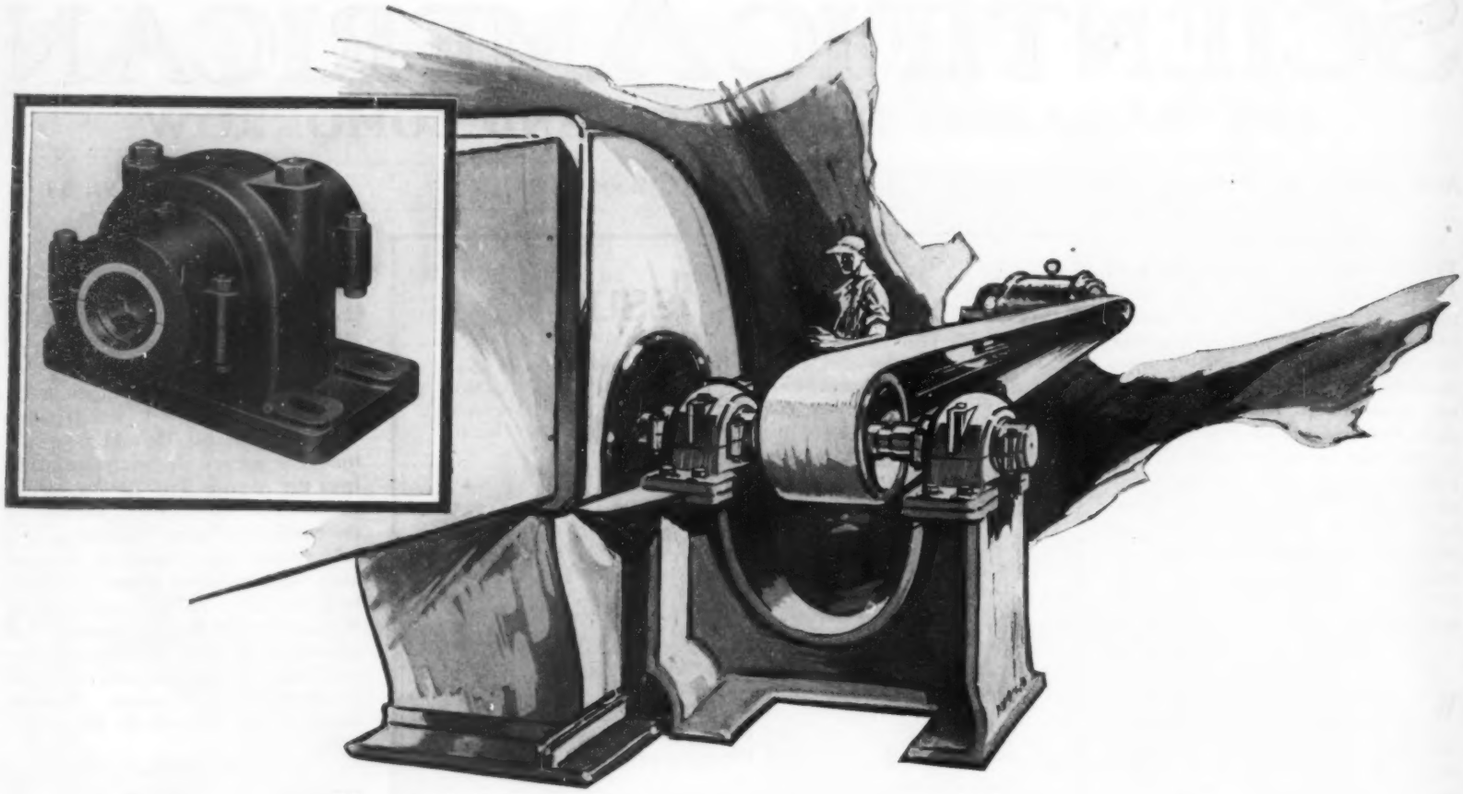
WARNING

THOSE human blood-suckers, the promoters of worthless stock-jobbing corporations, are now said to be getting ready to capitalize the unusually great volume of recent newspaper talk concerning American rubber-growing potentialities. Guayale, a Mexican shrub, is to be the bait, thinks the *India Rubber World*.

Guayale will furnish rubber, although too much by far has been said in its favor. What the small investor may omit to see is that a corporation, organized ostensibly to exploit rubber, may possibly regard this as the last thing it intends to do. To sell stock there must of course be a plausible pretext. And now that the people have been hearing a good deal about rubber, that commodity furnishes a glorious pretext for the crooked stock-jobber.

LOCOMOTIVES

THE newest locomotive of the New York Central Railroad, Number 1200, during a recent test, pulled a train of 108 freight cars at a speed of 32 miles per hour without the least indication of strain. Although this new leviathan of the rails is of the electric type, she calls to mind one of the former crack engines of the same road, Number 999. Over 30 years ago, this engine set what is believed to be still a world's speed record by traveling at a rate of 112.5 miles per hour. Number 999 is now retired and on exhibition, but about five years ago, she had been superseded in passenger work and had been reduced to the lowly occupation of hauling milk trains over the same rails that she once ruled. This prompts the thought—what manner of engine will surpass the power of Number 1200, and what will be her final occupation in railroad service?



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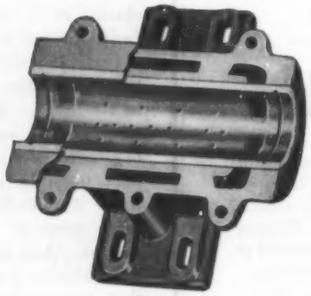

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Jones-Willamette Ball and Socket Bearings are self aligning and will stand up perfectly under the most severe operating conditions. Vacuum circulation of oil within the bearing itself, an exclusive Jones-Willamette feature, cuts to a minimum power losses due to friction. Surprising oil economies result, since the lubricant cannot leak out of these bearings. And such proof of bearing inefficiency as overheating, cutting and excessive wear are unknown where Jones-Willamette Bearings are installed.

Machinery manufacturers in various fields are using these vacuum-circulation bearings. If you plan the purchase of new equipment specify "Jones-Willamette equipped." We can supply you direct with replacement bearings in standard and special types to fit machinery now in operation. A few such installations in your plant will tell their own story. Correspondence is invited.

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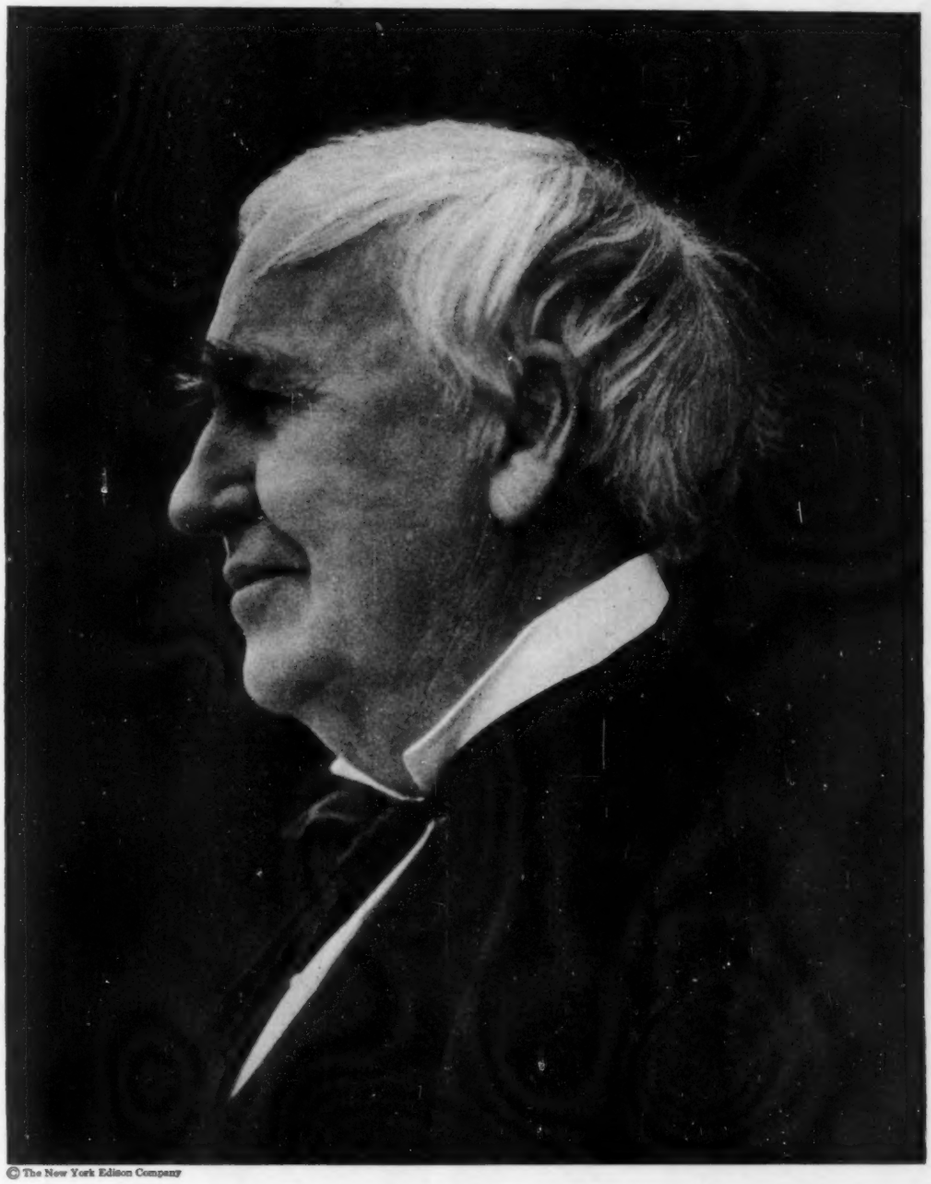

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Thomas Alva Edison, One of the First Radio Experimenters

In the year 1875, Edison conducted a series of experiments with a form of electricity that had not been known before that time. So new and so unusual were his results, that the now great inventor gave the name of "etheric force" to the discovery. Little did he think at the time that he was hovering on the brink of a system that, within the span of his lifetime, was to make possible communication around the world without the use of connecting wires. It is to be regretted that Edison did not further his experiments, for if he had done so, the development of radio communication might have been speeded up by many years. Later in his career, the wizard of electricity, as he has come to be known, discovered that an incandescent electric light bulb was doing more than giving out light. He found that the filament was producing a quantity of electrons and that the electron stream would carry a current of electricity. But here again he stopped just short of a master achievement and left the development of the radio vacuum tube, whose functioning depended on the electron stream that he had discovered, to later investigators. It must be remembered, however, that in radio as in many other fields, Edison has blazed the way.

Courtesy of the "Illustrated London News"

Looking Straight Down on the Crater of Mont Pelée

"What does Mt. Pelée look like now?" one is prompted to ask when the terrible outburst of that volcano is spoken of. It was on May 8, 1902, that this volcano, situated on the West Indian Island of Martinique, burst into a great eruption which utterly overwhelmed the city of St. Pierre, killing 40,000 and sparing but a single soul, a man who had taken refuge from the fiery blast in a masonry structure. Today we may fly over the grim crater in an airplane, observing its nearly quiescent cauldron. In the illustration, taken from a height of 4,000 feet above the summit, or 8,000 feet above the level of the sea, a cooled and hardened stream of lava may be seen. At numerous places small areas still show slight activity in the form of steam and gases, while the crater's rim shows distinctly, broken in only one part of its circumference.

The Multiple Eyes of Insects

Insects Have Many Eye-lenses. Do They See a Separate Image with Each Lens, or a Single Image as Does the Human Being? Recent Experiments Show that Certain Established Beliefs About Insect Vision Are Wrong

By H. Eltringham, M.A., D.Sc.

How does the insect see? Does it see what you or I see, and in the same manner, or is there a generic difference between human eyesight and that of insect life? Offhand, perhaps, one might say there is only one way to see, and that is to see things as they really *are*. A little thought should soon convince us, however, that even we do not see things in that manner. A box, for example, may be a cube, yet do our eyes not tell us it tapers away from us? True, our brain, accustomed by experience to dealing with such things, *interprets* this erroneous impression and assures us that the box, which our eye saw in perspective, is cubical.

Now, when we come to the vision of the insect, we find that Nature could not provide it with eyes of the kind large animals have, for the insect is too small. This raises an abstruse matter, involving the physical principle of "resolving power;" here we can simply state that the larger the eye lens, the finer the distant detail that it can resolve or descry. Whatever method the insect uses must, then, dodge the question of resolving power. The insect eye is made compound and the image is a mosaic of light and dark dots. In the euconic eye such as that of the bee, the effect is something like our own vision, except that the lenses are so small in aperture that rays of light from closely adjacent distant points form overlapping images and the detail of the object is unresolved. Some insects fly rapidly past an object, getting several images of it. This gives them a directional sense. —*The Editor.*

THE eyes of insects differ from the single-lens eyes of vertebrate animals in having many lenses or facets. This fact has long been known and many attempts have been made to discover exactly how an insect sees.

Our own eyes produce on the retina or nervous layer at the back of the eye an inverted image of the whole field of view, just as does a camera lens on the film or focusing screen at the back of the camera. Through interpretation based on experience we are not conscious that we see everything upside down.

In the eye of an insect, each lens undoubtedly produces an inverted image, and early experimenters, having seen these images by looking at the back of the layer of lenses with a microscope, not only concluded that the insect must see a multiplicity of inverted images, but they photographed these images and published the result as a reproduction of the kind of view an insect obtains.

It was of course necessary to suppose that the nervous mechanism combined all these images into one. In spite of excellent anatomical research by Grenacher and others, the first really reliable information concerning the action of insects' eyes was given by Exner, who worked out, both practically and mathematically, the true action of the facets of these compound eyes.

Two Kinds of Insect Eyes

Figure 1 shows a section of the eye and part of the brain of a small "tortoise-shell" butterfly. At A is the external or corneal layer, consisting of a great number of lenses, about 5,000 to 6,000 in each eye. Lying beneath each of these lenses is a secondary lens called the cone. The cones (C) are embedded in a mass of pigment which serves to prevent the light rays which enter one cone from interfering with those entering adjacent cones. Each cone tapers off into a delicate transparent rod (called the rhabdom) which passes inwards towards the brain and ends near the membrane E. The area occupied by these rods is marked D. At B there is a thin layer of transparent material separating the lenses from the cones. Packed round each transparent rod are eight slender nerves which can best be seen in a transverse section. These nerves pass in bundles (F) to the brain in which are found the two optic ganglia, G and H.

Two kinds of cones are found in insect eyes. The first, found in the eyes of flies, dragon-flies, and other insects, are called pseudocones, or false cones, and they are of a soft, semi-fluid material. The second kind are found in the eyes of beetles, butterflies, and probably bees, wasps, et cetera. These cones are harder and of a material resembling that in the lenses. They are called eucones.

Now it can be shown that while the pseudocones have little optical effect except the mere concentration of light, the eucones have a remarkable

CROSS-SECTION OF BUTTERFLY'S EYE AND BRAIN

FIGURE 1: *The curved, external layer of the eye swings around the whole top and right side of the picture. The brain lies below, in the center. Between these two lie the several parts explained in the text at the left. A butterfly's eye is quite different from that of an ordinary fly*

property. Their refractive index varies from the center to the periphery, and Exner has shown that they receive the inverted image from the lens, and not only reinvert it, but pass the resulting erect image down the transparent rod in the form of parallel instead of divergent rays.

Figure 2 is a diagram of a single element of a butterfly's eye. L is the lens, T the layer of transparent material, C the cone, R the transparent rod, and N the nerves. There is also an arrangement of air tubes by which each nerve has its own air supply, but these are omitted from the drawing. To the right are shown sections at different levels.

Let us study the pseudocone eye first. Each lens does not take in the whole field of view but only a very small part of it. Indeed, owing to the isolation of the cones by the pigment, only the rays of light which fall nearly perpendicularly on the lens can penetrate to the nervous system. In other words, each lens records only its own minute portion of the whole field of view, and of that it forms a very small inverted image. As an *image* it is of no value, because the cone, not having the resolving power of a lens, merely records the result as a minute spot of light, pale or dark, according to the average value of the light received by the lens. If one element or facet thus merely registers a dot of light, the whole series of elements will merely record a great number of light spots of varying intensity. How then can the insect see?

Flies See "Half-tone" Images

The reply is that, provided the elements or facets are sufficiently numerous, there is no reason why it should not see very well, although only for a short distance. A picture made up of light and dark dots is so familiar an object that we cannot look at an ordinary illustrated newspaper without seeing an example. Figure 3 shows two portraits which were produced in this way. It will be seen that one is rather coarse, being produced by a comparatively small number of dots, while the other is much finer in both shading and definition, although it is also produced by minute dots. The only difference is that in the finer portrait, the dots are much more numerous.

There can be little doubt that insects such as flies and dragon-flies which have pseudocone eyes receive just this sort of image on the nervous layer at the back of the eye and, of course, the image so formed is erect and not inverted. The evident keen sight of a large dragon-fly is due to the great multiplicity of the facets in its eye. Some dragon-flies eyes are said to have over 20,000 lenses. These and other insects cannot, however, see distinctly at any great distance. It can be shown that the number of facets engaged in viewing a given object varies inversely as the square of the distance between that object and the eye. This means that, supposing 100 facets are engaged in forming the image of a certain object one inch away, at two inches only a quarter of that number, or 25, would be available, while at

three inches only about 11 facets would be used. The "dot" image therefore becomes rapidly coarser and less well defined.

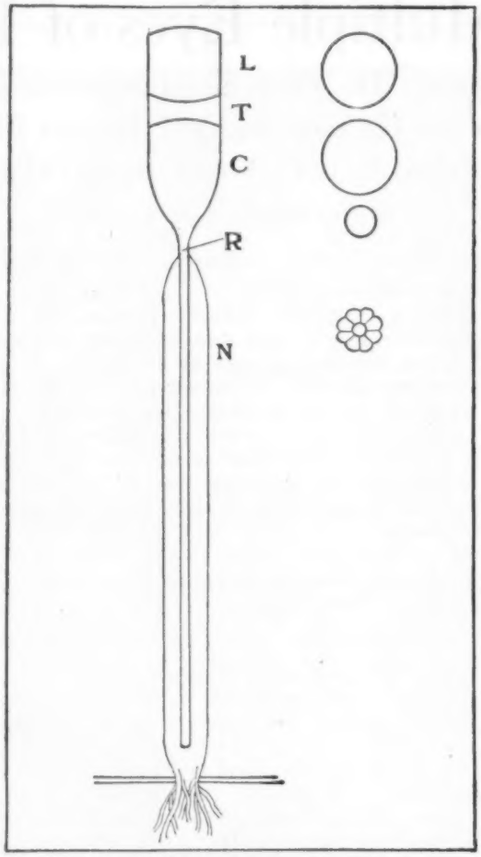
Now let us consider the eucone eye. Here the cone has a definite optical effect, and, as has already been stated, it re-erects the image formed by the lens so that at the point or inner end of the cone there is a minute but erect image of that part of the field of view included in the "angle" of the lens. Obviously a large number of such small erect images will make up a complete erect image of the whole field, just as a set of toy blocks will, when arranged in the proper order, reproduce the whole original picture from which they were cut. Exner succeeded in demonstrating this fact, by means of his discovery that in the eye of the glow-worm the cones are so firmly attached to the lenses that the nervous and pigmentary substances can be cleared away from the back of the eye and the purely optical apparatus examined in an intact condition.

Are Insects Color Blind?

By mounting such a prepared eye on a minute drop of dilute glycerine having a similar refractive index to that of beetle blood, and focusing at the plane of the nerves, while some object was placed in front of the outer surface of the eye, he was able to see the image and also to photograph it. The present writer has repeated some of Exner's experiments, and Figure 4 is a micro-photograph of a portrait, taken through a glow-worm's eye in the manner described. The actual area of the image is only about .15 of a square millimeter, so that in enlargement, much of the definition is lost. In the actual eye the view of any external object is remarkably clear.

The eye of a butterfly can be shown to act in much the same way, although owing to the delicacy of the cones, it cannot be prepared so as to furnish a suitable image for photography.

There has been much discussion in the past as to whether insects can distinguish colors, although the question put in such a way is too vague to admit of a concise reply. No doubt many insects would have no use for the power of color vision, but butterflies, associated as they are with their own colors and those of flowers, would scarcely be expected to be color-blind. At least one experimeter has however asserted, with an alleged weight of evidence, that all insects, including butterflies, are color-blind. Space will not permit of a description of the somewhat lengthy experiments carried out by the writer in the endeavor to throw some light on this subject. However, a brief summary may be given.



SINGLE ELEMENT OF A BUTTERFLY'S EYE

FIGURE 2: *Highly magnified, this is a single one of the elements shown in Figure 1, from A to E. L is the tiny lens; T, the transparent layer; C, the cone; R, the transparent rod, and N, the nerves. At the right of this drawing are shown cross-sections of each of these parts*

Inability, to see red is one of the commonest forms of color-blindness. A pure red, transparent dye was therefore painted over the eyes of some tortoise-shell butterflies. Had the insects been blind to red, they would thus have been altogether blind, since none but red rays could reach the nervous layers of the eyes. They did not prove to be blind when so treated, since they flew to the light, and when liberated could fly in a purposeful manner and alight with precision.

In a further experiment, a large bed of asters was chosen as a test, and it was found that the purple asters were the most conspicuous to the human eye on account of their color. The butterflies also selected the purple asters in the majority of cases. Photographs were then taken of the flowers, using a succession of screens which cut out portions of the spectrum, so that the plates were rendered blind to red, blue, green, yellow and so on. In every case the photograph showed the purple asters to be *less* conspicuous than when all the rays of light were in use.

Butterflies Can Distinguish Colors

Paper models of a small "fritillary" butterfly were set up where the insects themselves were common. Dead and dried insects of the same species were also used, and some of both the paper and the real models were dyed all kinds of unnatural colors. Not only did the live insects pause over the naturally colored models *only*, but in more than one case, a butterfly stooped to and examined a single broken wing of one of the dried specimens which had been thrown on the ground, although there must have been many small objects lying about which were of the same luminosity but not of the right color. In one case a butterfly did examine another object on the ground, and this proved to be a golden bronze bud-scale of exactly the same color as the insect itself. In only one case was an unnaturally colored model noticed at all. This was late in the day when the butterflies were feeding on the blue "bugle" flowers, and the model examined was a blue one, showing that the insect had momentarily mistaken it for one of the flowers.

These and other experiments, together with a full account of the anatomy of insect eyes, will be found in the author's paper on "Butterfly Vision" in the Transactions of the Entomological Society of London for 1919.

The huge yet almost human machinery that aids in turning out all-steel automobile bodies in practically one metallic unit will be described and illustrated in a forthcoming issue.

HOW SOME INSECTS SEE—A MOSAIC OF SPOTS

FIGURE 3: *Half-tone illustrations that give an idea of how an insect sees objects. Both are composed of minute dots. In one, the dots are simply larger than in the other. The distances between the dots represent the lower limit of fine detail which the insect can descry. To grasp the kernel of "resolving power" consult any college physics text book. It governs ultimate seeing in telescope, eye and microscope*

TAKEN THROUGH THE EYE OF A GLOW WORM

FIGURE 4: *This micro-photograph is greatly enlarged, which accounts for its blurred outline. It is therefore not the exact way an insect sees. The original from which it was enlarged photographically was actually smaller than this period. Some insects get a very poor idea of objects farther away than about one foot. A spider, however, can see you clearly. The same is true of the bee who can see flowers from afar*

The Month in Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By Morris Fishbein, M.D.

Editor of the "Journal American Medical Association" and of "Hygeia," the Health Magazine

Ventilation and the Common Cold

SUPERSTITIOUS beliefs as to the causation of disease occur with greater frequency in relation to the common cold than to almost any other type of disease. One hears much discussion of drafts, of moisture, or over-exercise, of wrong diet. As a corollary everyone has a favorite remedy which he believes is of value. Almost all observers, including many physicians, overlook the fact that the disease is apparently self-limited and in the large majority of instances tends to get well without any medical treatment, except rest and proper control of the bowels. There are times when the disease seems to spread more rapidly than at others, when more persons are affected, and when some persons are affected more seriously. Furthermore, there are persons who rarely have colds, whereas others seem to succumb eight or ten times a year.

Extensive investigations have been made in many of the universities of the country to find out whether or not some of the common factors usually referred to are actively concerned in the causation of colds. Dr. D. J. Smiley of Cornell University studied such factors as over-exercise, cold baths, loss of sleep, drafts, kind of underwear worn, kind of shoes worn in wet weather, perspiration after exercise, constipation, mouth breathing, removal of the tonsils and adenoids, and heredity. He was compelled to conclude that not one of these factors could be considered the actual major factor in the causation of disease.

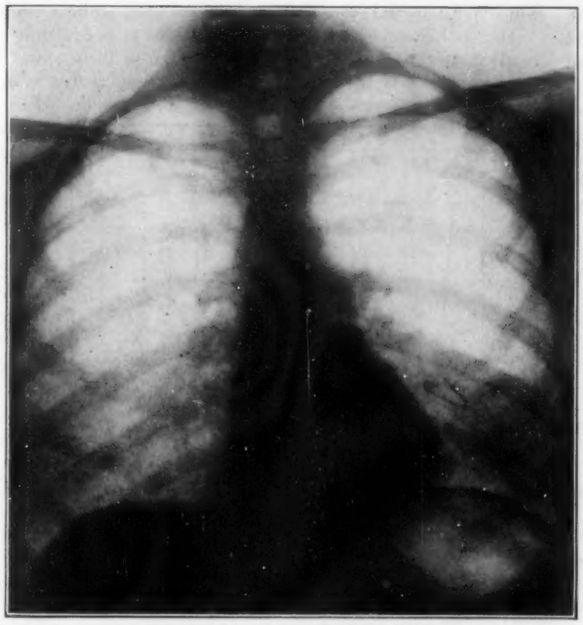
Now Dr. William H. Barrow of the Stanford University supports similar investigations with particular reference to the matter of climate. He found that the extremes of climatic conditions experienced in Massachusetts and New York State as compared with the more temperate climate of California is not a factor of major importance in catching cold. The various systems of heat used, such as coal or wood stoves, steam heat, hot air, gas heat, oil stoves, or no heat at all, did not seem to influence in any way the numbers of colds. He also found that it made little difference whether the students slept on a sleeping porch, a well ventilated bedroom, or a poorly ventilated bedroom. He found, finally, that persons who came to California from other climates had just about as many colds in California as when they were at home.

The evidence would seem to point more and more to the belief that the cold is caused by some definite bacterial organism which grows best in the bodies of certain persons, who provide it with what might be called an optimal soil. This soil is obviously a matter of the ability of the person to resist disease through placing his body in the best possible physical condition.

Foreign Bodies in the Lungs

NOT infrequently babies, or even some adults, inhale metallic substances, buttons, teeth, or similar objects into the lungs and, having no immediate severe symptoms, continue to carry these bodies about until changes occur in the tissues with serious results. Dr. W. F. Manges of Philadelphia has recently analyzed instances of this kind which have come to medical attention. In one instance, a child inhaled a screw which it had in its mouth, and which blocked one of the main passages into the lungs for a period of one year and nine months before the mother undertook to secure medical consultation. As a result of the presence of the screw in the main passage to the lung, the tissue became inflamed, the heart became displaced, and yet when removal was accomplished the tissues returned to normal. Of course, the passage was not completely blocked, or there would have been a serious destruction of the lung tissue.

In other instances, tacks, staples, nails, collar buttons, shawel pins, beauty pins, pencil caps and pieces of bone have been inhaled and kept in the lungs for a considerable time. In the most severe case, a child inhaled some coffee beans which were kept in the lungs for 32 years. In every instance in which a study was made, it was found that the presence of a foreign body in the lungs causes the formation of exudate or pus, with a thickening of the lung tissue and some bleeding. Frequently the symptoms resemble those of tuberculosis, and medical attention is first called with that diagnosis in view. When the foreign body is extracted from the lung, the patient usually recovers promptly.



PIN LODGED IN CHILD'S LUNG

The pin was swallowed when the child was three years old. It was located 18 years later, by means of X rays

The Parathyroid Hormone

AMONG the most interesting glands in the human body are the parathyroid glands, lying behind the larger thyroid gland in the throat, the latter being closely associated with the disease known as goiter. A few years ago, Dr. J. M. Collip, who as a physiologic chemist, aided Drs. Banting, Best and MacLeod in the isolation of insulin, began a series of investigations which have led finally to the preparation of a stable and standardizable extract which contains the active principle of the parathyroid glands. The work is so new that the exact value of the material in the treatment of disease has not been definitely determined. On the other hand, it may reasonably be predicted that it will have a real value in any condition in which the secretion of the parathyroid glands is deficient.

Sometimes, following an operation, the patient develops tetanic movements or convulsions which seem to be definitely associated with a lack of parathyroid secretion. In a few cases, the giving of the new parathyroid hormone seems to have had a specific effect leading to recovery. There are also spasmodic conditions of infancy which seem to be associated with a similar deficiency, and specialists in diseases of children are already reporting cases in which the giving of the new preparation seems to yield excellent results.

Through experiments made in laboratories of physiology, it has been shown that the parathyroid glands are definitely associated with the manner in which the body uses calcium and phosphorus. When the parathyroid glands are removed, there is usually a lowered amount of calcium in the blood and an increase in the amount of phosphorus. When the new extract is given to dogs whose parathyroid glands have been removed, the amount of calcium in the blood rises and the amount of phosphorus, if increased, decreases. There are, of course, several human diseases in which the amount of calcium in the blood is deficient. Among these are postoperative tetany, spasmodic conditions of infancy, tropical sprue, and some forms of inflammation of the kidneys.

It is logical to believe that the new preparation may have virtues in the treatment of these conditions. Such reports as are already available indicate that the parathyroid extract constitutes a valuable addition to the medical armamentarium.

Hearing Through the Skin

PROF. ROBERT H. GAULT of the department of psychology of Northwestern University recently reported the results of experiments made under the auspices of the National Research Council to determine the extent to which a fingertip might be made to do the work of the ear. Persons found to be totally deaf as studied with modern sound-producing devices, were the subjects of the experiment. It was recognized that what a person says is made up of a combination of rhythm, accent, emphasis, and varying tempo of sound, and of moving lips, facial expression and gestures. Prof. Gault points out that the deaf who are able to comprehend by lip reading lose certain characteristics of speech. It seems possible that these may be supplied to some extent through the skin.

In his experiments, Prof. Gault used an electromagnetic receiver and a transmitter. The receiver is held in the hand. An amplifier is in circuit between the transmitter and the receiver. All vibrations within the system are amplified approximately 175 times. When the tip of the finger of the listener rests lightly against the diaphragm and someone speaks into the transmitter, the listener feels the vibrations of the diaphragm. Prof. Gault found by this method that trained listeners were able to sense by the feeling of the diaphragm the sounds of speech, and that they could learn to identify various vowels and diphthongal qualities.

Eclipsing Variables

Stars Which Revolve in Pairs, Somewhat Like Dumbbells, Alternately Eclipse One Another. Recent Studies of Such a Pair Strikingly Confirm the Previous Theories of Astronomers Concerning the Several Characteristics of the Stars

By Henry Norris Russell, Ph.D.
Professor of Astronomy, Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

SCIENTIFIC activity varies to a remarkable degree from one country to another. In some nations, although material resources are great and education widespread, the advancement of knowledge is relatively small; in others it is unstable. To attempt to list the names at the lower end of the list would be a thankless task; and to award the highest place would be a delicate matter. But there can be no doubt at all that a very high place—close to the top, if not actually there—belongs to Holland.

The population of the Netherlands is not great, but the scientific work that comes steadily from that small country is remarkable, both for its amount and its quality. This is true in many fields—physics and biology, for example—and it is true also of our chosen topic of astronomy.

The Dutch observatories, a few years ago, realizing the desirability of cooperation, joined in the publication of the *Bulletin of the Astronomical Institute of the Netherlands* and this journal, from its first issue, took a prominent place in the current literature of the science. Many branches of investigation are included among the researches which it publishes, and perhaps the prettiest bit of work which can be found in all the accumulated literature of last summer is among them.

An Eclipse Every Nine Hours

This report comes from Leyden, and from the pen of one of the younger members of the observatory staff, Dr. van Gest, who has been engaged in the measurement of starlight by photography.

The photometric observer is always on the lookout for promising objects to observe. Stars which vary in brightness are his delight; and if he has any love of theory, he welcomes most of all a case in which he cannot only make observations, but interpret them.

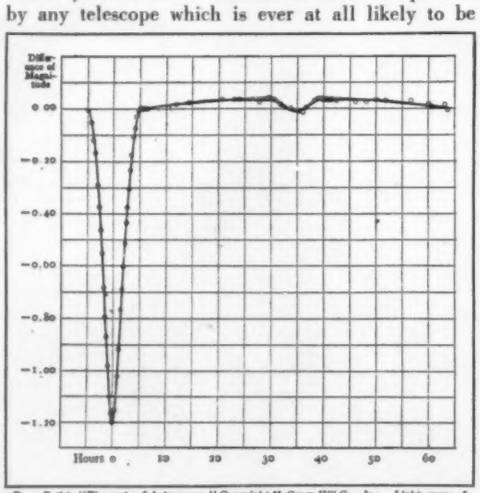
Eclipsing variables—in which a pair of stars, revolving about their common center of gravity, alternately eclipse one another—give such an observer a fine chance, for he can find out from his observed "light-curve" a great deal about the size, brightness and density of the two stars. Such systems are often discovered casually—in the course of a general examination of all the stars on a set of plates in order to pick up any that may change in brightness. Sometimes, however, they may be deliberately sought—the observer taking a star which is known to be double anyhow, by spectroscopic observations, and measuring its light to see whether eclipses occur.

Sometimes his labor is in vain; the orbits of the pair are tipped at such an angle that they pass clear of one another, and no eclipse happens; but, when the observer uses good judgment in making his working list, he very frequently meets with success.

Dr. van Gest—guided by the very competent advice of Professor Hertzsprung—has worked upon an apparently insignificant star, which turns out to be of exceptional interest.

The bright star Castor (Alpha Geminorum) is known to all observers as one of the finest doubles in the sky. The two brilliant stars, some five seconds of arc apart, can be separated with a small telescope. The observations of the last two centuries show that they are in slow orbital motion, with a periodic time of three or four hundred years. But this is not all. More than a minute of arc away is a faint star of the ninth magnitude—less than 1/600 part as bright as the leading component of the pair—which is moving in space along with the other two, and shows evidence of a very slow orbital motion—revolving about the bright pair in a period which must be many thousands of years in length.

The spectroscope shows rapid changes in velocity in all three of these stars, proving that each of them is a very close double—far too close to be separated by any telescope which is ever at all likely to be



From Fath's "Elements of Astronomy." Copyright McGraw-Hill Co., Inc. Light-curve of Algol, according to Stebbins

BEHAVIOR OF A TYPICAL ECLIPSING VARIABLE

As an example of this type, Algol's brightness remains almost uniform for over two days, then in five hours it decreases markedly, but recovers its former brightness in five hours more

built. This is due to the rigid limitations set by the consideration of resolving power.

For the brightest star, the period is about nine days; for the other conspicuous one, just less than three days. In both cases the companions are too faint to be detected—their light is drowned out by the glare of their primaries. But this does not mean that they are "dark stars."

The parallex of Castor has been very carefully measured, and its distance is known to be 45 light years (with an uncertainty of perhaps 10 percent). It follows that the brighter star is 24 times and the fainter one 11 times as luminous as the sun; so that the "dark" companions might each be a good deal brighter than the sun itself and yet be hopelessly lost to observation. The distant component, however, is a really faint star, giving off only 1/30 of the sun's light. The spectroscopic observations (made at Mount Wilson by Adams and Joy) show that it is composed of two stars of equal brightness, revolving on the very short period of 19 hours 32 minutes, but with the high velocity of 230 kilometers per second.

It is this faint star which Dr. van Gest has photographed, and he finds that eclipses actually occur in which the light of the system is reduced by 40 percent. The two close components alternately eclipse one another partially at intervals of 9 hours and 46 minutes.

The eclipses last only a little over two hours, showing that the stars are fairly small, in comparison to the interval between them—the diameter of each being not quite one-third of the distance between their centers—assuming, as must be nearly true, that they are of the same size.

The spectroscopic observations give the scale of miles of the system, and show that the components are 1,600,000 miles apart, and that each is 520,000 miles in diameter—three-fifths as big as the sun. This is the smallest size so far found by direct observation for any star.

From the distance and period, it is found that each star has 52 percent of the sun's mass—from which it follows that their mean density is 2½ times the sun's, or 3½ times that of water. This is again noteworthy, being far greater than for any star previously studied in this fashion—although, of course, nothing at all when compared with the Companion of Sirius.

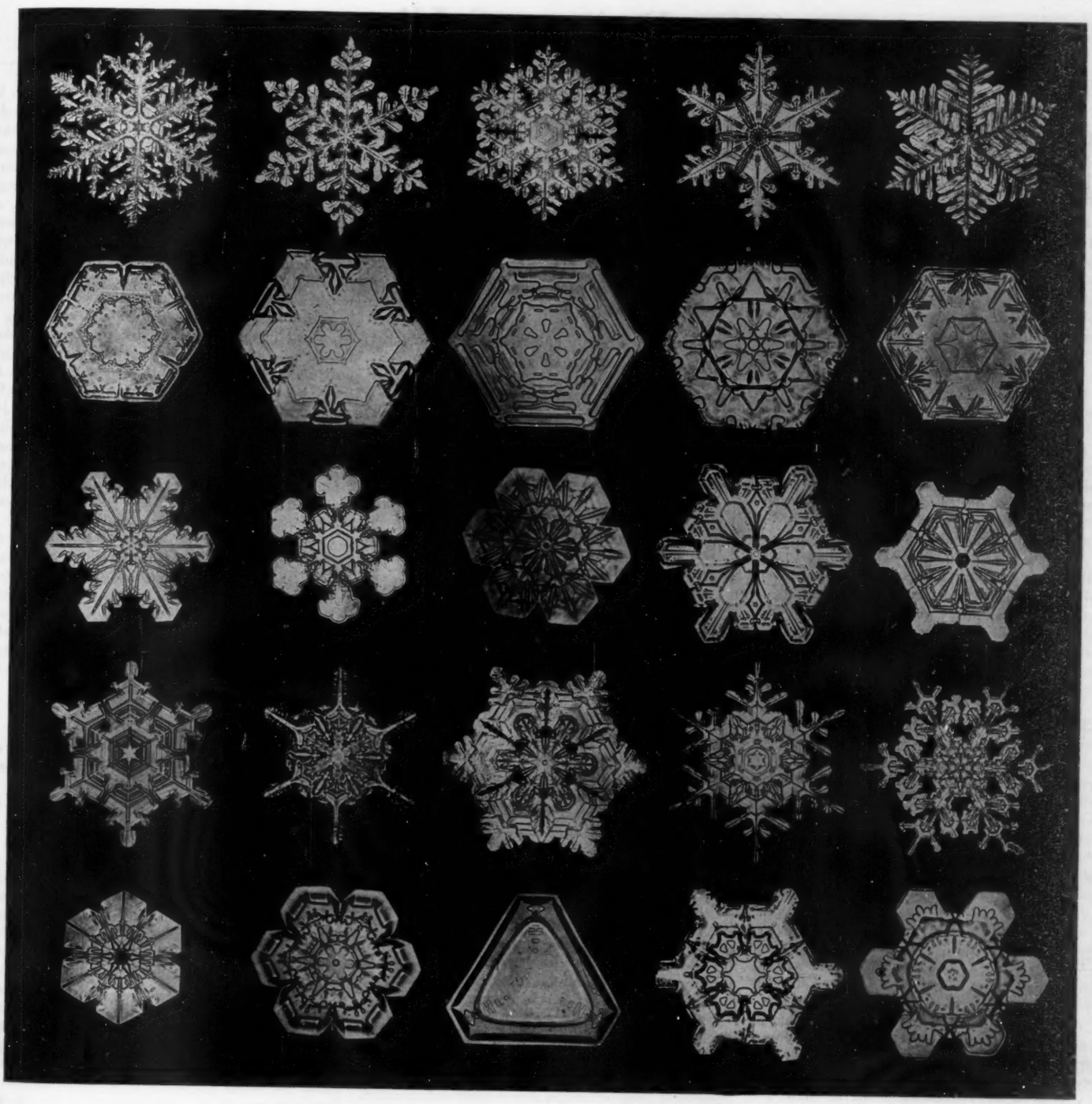
The Best Known Star of All

But still more remains. The distance and real brightness of the system are known. Each component gives out 1/60 as much light as the sun, from a superficial area which is 36 percent of the sun's. It follows that the amount of light emitted per square mile of surface from these stars is only 1/21 as much as from the sun. This shows that they cannot be nearly as hot as the sun, and calculation from the laws of radiation indicates a surface temperature of 3,500 degrees, Centigrade. This is in perfect agreement with the spectrum, which is of Class M, typical of the red stars of low temperature.

Putting all these things together, it may fairly be said that we now know more about this little star than of any other. Distance, brightness, size, mass, density, color, temperature—all are known. They are known pretty accurately too—or they soon will be when a little more work has been done on the spectroscopic orbit. The star is a typical red dwarf, rather brighter, and probably a little bigger, more massive, and hotter than most dwarfs of Class M, but a good sample, just the same.

It is a striking evidence of the advance of our knowledge that all its properties now appear entirely normal—agreeing closely with those which might have been predicted from our general knowledge concerning the stars. But the direct confirmation of these predictions, by clear and positive evidence in a typical case, is of great value to all who are interested in astronomy.

One more remark should not be omitted. Dr. van Gest observed with a rather small telescope—13 inches in aperture—and, on this plate, the image of the faint star was only 1/12 of an inch from that of the far brighter pair. To obtain these good measures under such difficulties deserves special praise.



Marvelous Crystal Structures From Cloudland

It was the presentation of a microscope by his mother while he was in his mid teens, that prompted W. A. Bentley to commence the study of snow crystals. With this instrument he first observed the beautiful forms that these crystals often take, and with boyish enthusiasm he attempted to sketch them. This method did not prove satisfactory and soon a photo-micrographic system was tried. After many failures, success was attained and from that day forward, Mr. Bentley has been pursuing his interesting hobby, not for financial gain but for the pure love of the subject. Besides a microscope capable of magnifications of from 8 to 60 diameters and an extension camera coupled to it, other accessories were found necessary. These included an observation microscope, glass slips, a black board on which the crystals were to be caught, a pointed wooden splint to pick up the crystals, a duster for removing undesirable specimens and a feather to press the crystals flat on the glass slides. In actual practice the crystals were caught on the board and taken to the cold room indoors where the apparatus was located. They were then viewed briefly with the observation microscope and if of sufficient individuality, they were pressed flat on a glass slide and photographed. After several years of snow-crystal study some interesting data was collected. In the location that happened to be chosen, Vermont, the crystals collected during storms when the snow fell from the western quadrant were found to be best. The most favorable snowfalls were found to occur during or at the end of a cold snap attended with below-zero weather. Photographing was found to be possible at temperatures of from 26 degrees, Fahrenheit, downwards, and some of the results are shown in the photographs reproduced on this page. After years of work, it was found that the first location, chosen by chance, was the best of many subsequently tried. Crystals of the same fine symmetry and in fairly large quantities could not be found elsewhere.

Our Point of View

The "Human Interest" Reporter

IT is amazing that in this age of scientific and technical advancement, and in view of the wide and ever-growing public interest in science, the editors of our daily papers should send reporters to write up great disasters such as the Florida hurricane, who apparently are more interested in getting out a sensational story than in bringing to light engineering lessons which lie hidden in every great physical disaster of this kind. In the first place, these scribes seems to be afflicted with a disease which for want of a better term, we may call "superlativitis." As a result, the figures of death and destruction are invariably multiplied some three or four times, and instead of the public learning the really serious lessons taught by the Florida disaster, they are regaled with the old, old story of seas washing up over seawalls and boulevards, of flimsy frame houses overturned and "smashed into kindling wood," of trees blown down, and so forth and so on. The point is well made by the *Engineering News Record* when it says that, "a reporter in Miami on that awful Saturday would have considered his fortune made if he had found a mother cat caring for a brace of puppies under one of the overturned boats in Royal Palm Park."

It seems to us that every great daily paper should include in its staff a trained technical man whose special field should be the investigation of railway wrecks, shipping disasters, and structural failures involving serious loss of life and property. Our daily press surely does not wish to cater merely to that class of moron, which will sit unmoved through the scenes of a first-class moving picture and burst into uproarious applause only when the face of a player is plastered with a well-aimed custard pie. As noted elsewhere on this page, the wonderful resistance offered by the tall buildings of Miami to the fury of the hurricane, answered a question which millions of people today must have asked themselves many times. Yet, this outstanding fact was passed over practically unnoticed.

Pure Science Research in Europe

THE Secretary of the National Research Council, Dr. Vernon Kellogg, on returning from several months abroad, states that we can no longer depend, as we have so largely done in the past, upon scientific research in Europe for future development. He thus emphasizes Secretary Hoover's recent call for the promotion of research in pure science in America. We are reminded that Germany, France and various other continental countries have for generations led the world in the study of pure science and that the United States has profited by the results. But Europe has received a staggering set-back in its pure science research work as a result of the stringent, economic conditions imposed since the World War. Europe has little money for anything but pressing immediate necessities. "Everywhere," says he, "I have met with the cry, 'We have little money for research; what are you in America going to do?'" We owe it to ourselves; nay, we owe it to the world at large, to turn a larger share of our enormous post-war wealth into the channels of pure science research.

The Future Transatlantic Liner

RECENTLY in these columns, we stated it as our opinion that no ships of the size of the *Leviathan* or the *Majestic* would be built, at least in the near future—this for the reason that the big shipping companies state that these huge vessels do not pay. We have before us, however, an issue of one of the leading London technical papers which states that definite suggestions for the building of a large ocean-going liner are being put forward by one of the leading British ship-owning firms. There is proof of this in the fact that the Clyde Navigation Trustees are being asked whether, if such a ship were built on the Clyde, she could be safely launched and taken to the open seas. The largest ship thus far built on the Clyde is the *Aquitania*, which is just over 900 feet in length. It seems that a ship 1,000 feet long would have sufficient launching space, since the building ways are so placed that large vessels can pass into the mouth of the River Cart which empties into the Clyde, approximately opposite to the building yard. It is evident that the urge to build a 1,000-foot ship is due to the fact that travel to Europe is so large in the summer that during the past season all big liners have been filled to capacity. Structurally, there is no reason why a ship of this, or even larger size, could not be built.

Steel Buildings Survive Tornado

The outstanding engineering fact after the late Florida hurricane had done its worst was practically ignored by the reporters who were despatched by their respective editors to the desolated territory. We refer to the fact that, with one or two minor exceptions, the towering skeleton-steel business buildings of Miami passed unscathed, so far as their structural integrity was concerned, through the terrific ordeal. Tall office buildings, also, of which the steel frame only was completed, showed the same strength and stability. This is the more gratifying when we remember that a unit pressure of only 20 pounds per square foot was used in designing these buildings as against the 30 pounds per square foot used in designing steel bridges. One partial failure was in the case of a 16-story building which was only three rooms in width, and some fourteen rooms in depth. The bending stress across the narrow width of the building strained the columns beyond their elastic limit and bent the building so that the cornice is nearly two feet out of the perpendicular. Sufficient reinforcement at the connections of floor beams with columns would have saved the building.

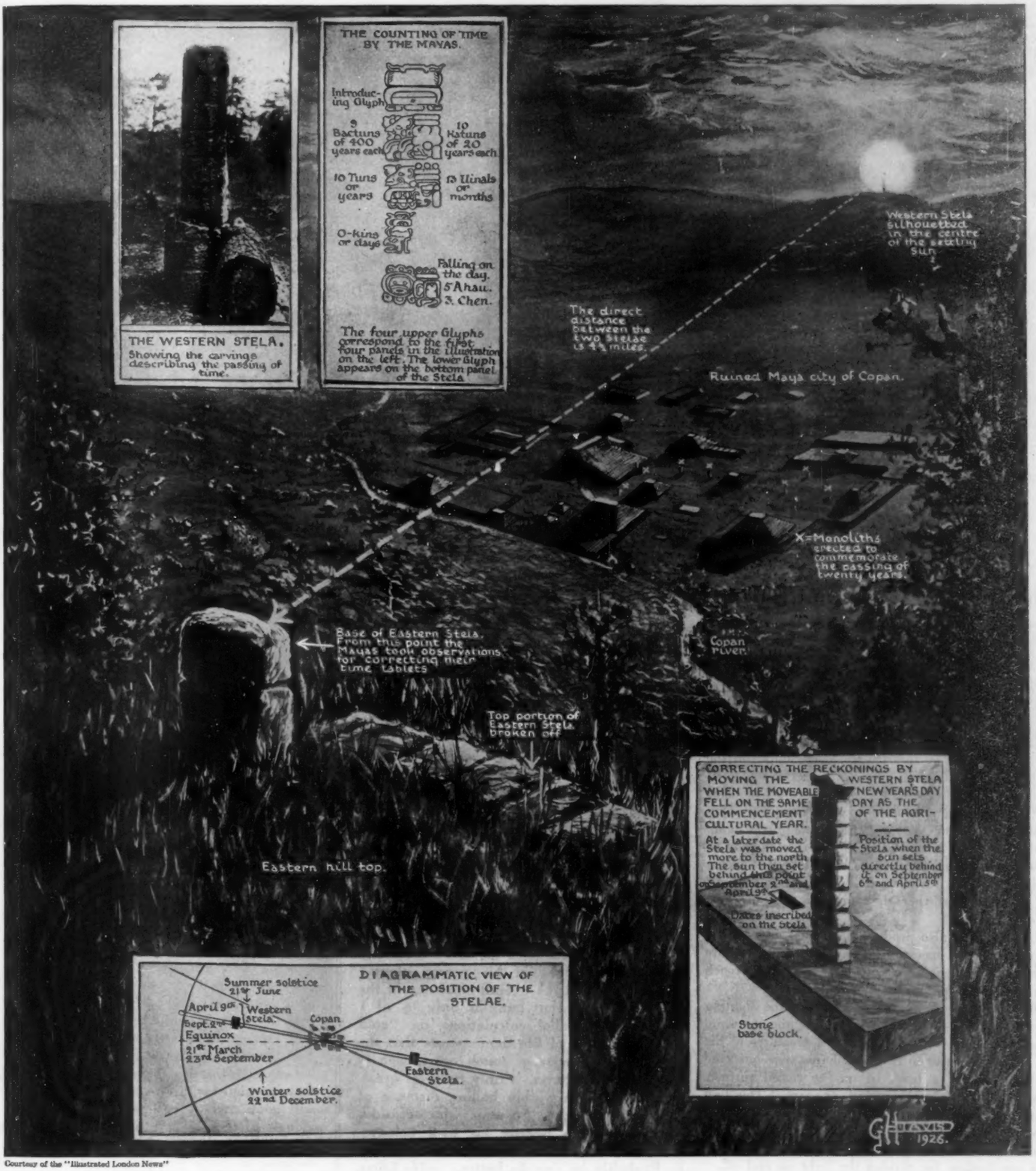
Filling in the East River

PERIODICALLY, we hear discussion of the problem of providing more building ground for New York by filling in the East River, and incidentally providing free intercommunication between New York and Long Island. Proponents of this scheme have all overlooked the most important element of the problem. Always they have failed to make any suggestion as to where the enormous amount of material could be obtained to fill in a vast pit from three to four thousand feet wide, with depths reaching 60 and 70 feet, and extending for many miles. All the excavated material from new buildings in New York, if dumped into the river, would make but a small impression, and if the material were sought nearby—as it would have to be to keep down costs—it would be necessary to dig up no small part of the adjoining real estate of Long Island. The principal motive behind this suggestion is, of course, to provide adequate communication with Long Island, which, together with New Jersey, will have to house the teeming millions of this rapidly growing city. To our thinking, the largest relief would be obtained by building the great 59th Street bridge across the Hudson River and connecting it by means of an elevated boulevard across Manhattan Island with a new bridge across the East River near the present Queensboro Bridge, which is already frightfully congested. This would enable the very large traffic between Long Island and New Jersey to pass over Manhattan Island without adding to the congestion on its streets, and it would make the vast, unoccupied areas of New Jersey and Long Island easily accessible by rapid transit trains, trolley cars and automobiles. Construction of this work would ease the situation for many years to come.

Closing the East River would be opposed by the Navy, on the ground that it would shut out the Navy Yard from direct communication with Long Island Sound. The possession of two independent routes to the Atlantic is of great value. Today, a blockading fleet would have to split its forces, placing one fleet at Sandy Hook and the other at Montauk Point. With the East River closed, it could concentrate at Sandy Hook.

Roller Bearings for Railroad Trains

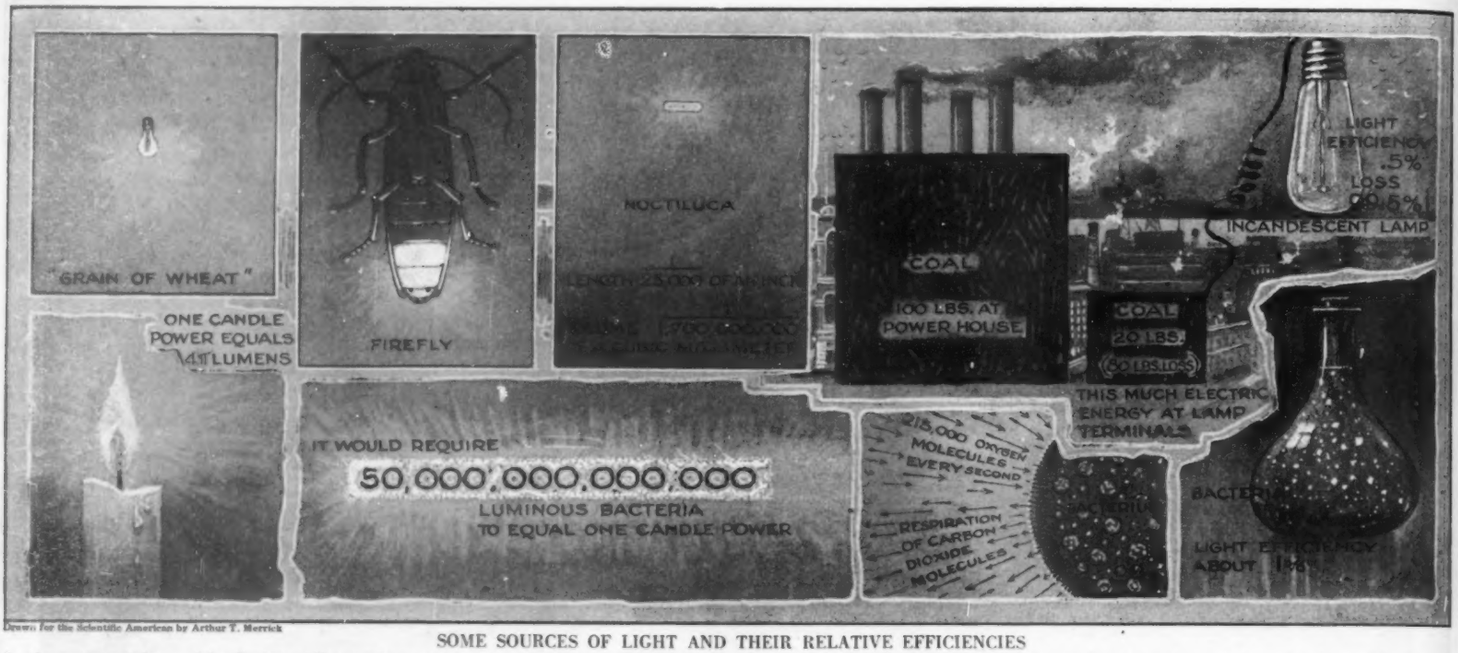
THE marvelous efficiency of the motor car is due in large part to its being equipped throughout with roller and other anti-friction bearings. Before the advent of the motor car, far-sighted engineers had been trying to develop anti-friction bearings for heavy passenger and freight cars. For lack of experience in the construction of such bearings, and because steel of the high quality necessary to endure the heavy unit stresses imposed was not available, these efforts met with little success. Today, however, the limitations of the roller bearing and the problems which have to be faced in its application to heavy axle loads are well understood, and it is gratifying to learn that one of the great transcontinental roads has successfully applied roller bearings to its through trains. The Chicago, Milwaukee and St. Paul Railway has announced that it is equipping its passenger trains with bearings of this type, which are being applied to a large number of new Pullmans and 64 of its own sleepers. This decision has been arrived at after two years of experimental work by this company, which announces that one of its standard test sleepers equipped with roller bearings has already traveled over 119,000 miles. The statement of results obtained in these tests is startling, for we are informed that a coach equipped with these bearings required 7.59 pounds of tractive effort per ton to start it, whereas another coach, with well-worn friction bearings of the standard type, required 54.4 pounds of tractive effort per ton—the total effort in starting being relatively 500 pounds as against 3,600 pounds per coach. The most valuable gain for the passenger is the absence of that surging and shock which is such an obnoxious feature of travel. After the train has started, the difference between the frictional retardation of the two types of bearing diminishes.


THE WESTERN STELA.
Showing the carvings describing the passing of time.
THE COUNTING OF TIME BY THE MAYAS.
Introducing Glyph
9 Baktuns of 400 years each
10 Katuns of 20 years each
10 Tuns or years
13 Uinals or months
0-kin or days
Falling on the day. 5 Ahau. 3 Chen.
The four upper Glyphs correspond to the first four panels in the illustration on the left. The lower Glyph appears on the bottom panel of the Stela
Western Stela silhouetted in the centre of the setting sun
The direct distance between the two Stelae is 4½ miles.
Ruined Maya city of Copan.
X=Monoliths erected to commemorate the passing of twenty years.
Base of Eastern Stela. From this point the Mayas took observations for correcting their time tablets
Copan River
Top portion of Eastern Stela broken off
Eastern hill top.
CORRECTING THE RECKONINGS BY MOVING THE WESTERN STELA WHEN THE MOVEABLE NEW YEAR'S DAY FELL ON THE SAME DAY AS THE COMMENCEMENT OF THE AGRICULTURAL YEAR.
At a later date the Stela was moved more to the north. The sun then set behind this point on September 2nd and April 9th
Position of the Stela when the sun sets directly behind it on September 6th and April 5th
Dates inscribed on the Stela
Stone base block.
DIAGRAMMATIC VIEW OF THE POSITION OF THE STELAE.
Summer solstice 21st June
April 9th
Western Stela.
Copan.
Sept. 2nd
Equinox
21st March
23rd September
Eastern Stela.
Winter solstice 22nd December.
1926.

Courtesy of the "Illustrated London News"

The Largest Sundial in the World

How the civilized Mayas kept accurate track of time was recently explained by Dr. Thomas Gann who has just conducted an archeological expedition in Middle America. At Copan, one of the oldest cities of the Maya Old Empire which flourished from about 100 B. C. to 500 A. D., two stone stelae or monuments (connected by the dotted line, above) have been discovered. These, according to Dr. H. J. Spinden of Harvard, form a gigantic sundial four and one-half miles across. Here "the sun, as viewed from the eastern stela, set behind the western stela every year upon a date which the Maya regarded as the beginning of their agricultural year. The most remarkable discovery," continues Dr. Gann in the *Illustrated London News*, "was the fact that the base of the eastern stela is *on an exact level* with the base of the western." "O Pop" was the Maya New Year, but their year contained only 365 days, with no Leap Year. Due to this, "O Pop," originally April 5, gradually fell behind an entire year.



Drawn for the Scientific American by Arthur T. Merrick

SOME SOURCES OF LIGHT AND THEIR RELATIVE EFFICIENCIES

In the accompanying article, Professor Harvey draws some interesting comparisons. Several of them are graphically illustrated above, and a comparison of these drawings with the text will be of assistance in comprehending the subject

Luminous Bacteria, the Smallest Lamps in the World

The Characteristics and Efficiency of a Lighting Plant of Twenty Quadrillionths of a Candle Power

By E. Newton Harvey, Ph.D.
Professor of Physiology, Princeton University

IN the National Academy of Sciences building in Washington is a tiny incandescent bulb, the "grain of wheat lamp," one-quarter inch long, which can be inserted in small cavities of the body for illumination during the performance of delicate surgical operations. If this were connected with a dry-cell we should have a complete man-made illuminating system. Small though the lamp is, its structure is easily visible to a keen pair of eyes. No microscope is necessary to take it to pieces and measure its various parts. This is true of all our machines, whether they produce light or heat or electricity.

Living things also produce light, heat and electric currents but the mechanisms involved are far more intricate. An engineer with his powerful wrench can easily unscrew the nuts of a dynamo.

With what tools are we to examine the lighting device of a fire-fly? Yet a fire-fly is one thousand times as large as some of the small creatures of the sea which give rise to the phosphorescence observed in the wake of a boat, or on the ruffled surface, when disturbed by the wind or oars. The best known of these forms is called *Noctiluca*, but there are many different kinds capable of lighting. They flash when touched or stimulated in any way. There is a mechanism for turning the light on and off.

In this respect they differ from still smaller creatures, the luminous bacteria. Figure 1. These also live in the ocean but they do not contribute to the phosphorescence of the sea under ordinary circumstances. They are so small that the light from a single one cannot be seen with the eye or with the microscope. It takes many thousands together to produce enough light to affect the retina. An individual of average size is a short cylinder with rounded ends, measuring 1.1 by 2.2 μ.* The volume is about one 1,700,000,000th of a cubic millimeter. It would take 40 million of them to fill a *Noctiluca* and 40 quadrillion to fill a man. If one of these creatures were enlarged to the size of a "grain of wheat" lamp, it would be over four billion times its actual size.

Imagine the difficulties of exploring the structure of such a machine as this. And yet we do know something about the light production of these tiny organisms, for they may be treated in bulk, as averages, just as we treat atoms and molecules. Quite a good deal is known about the structure of atoms and molecules. Light production by bacteria is chemical in nature and so our tools are the test-tube and the measuring glass.

Although luminous bacteria occur in the sea it is only when they grow in great numbers on some nutrient material like a dead fish, that we observe their light. Then the whole fish shines in the dark. Figure 2. These glowing fish were known to Aristotle; and Robert Boyle, inventor of the air pump, studied them in 1667. He showed, in fact, that under the receiver of his air pump the light disappeared, to return again when air was readmitted. Thus he demonstrated the necessity of oxygen for luminescence, although the word oxygen was not used at that time. Boyle had a keen insight into the meaning of his experiment, for he goes on to draw a comparison between a glowing coal and the glowing fish, both of which require air for the light. Both are combustions, but in luminous animals the combustion produces a very large amount of light in proportion to the heat produced. The temperature in some luminous animals during luminescence does not rise one thousandth of a degree. It is "cold light" indeed.

Luminous bacteria, unlike some other forms, are quite harmless. They are the first bacteria to appear on fish or meat, and only later are they crowded out by putrefactive varieties. They can easily be grown on ordinary culture media containing the right nutrient material. Figure 3, top. A flask inoculated with *Photobacterium phosphorescens* will glow like a ball of fire, and small individual colonies of bacteria scattered over the medium look like the starry sky. I have grown these bacteria in large pie plates and scraped off the organisms into sea water where they form a cold greenish-colored liquid fire.

A dense emulsion of bacteria in sea water uses up oxygen so rapidly that it must be continually shaken to dissolve more oxygen, otherwise the light will go out, remaining visible only at the surface where the bacteria are in contact with air. These bacteria can be used to detect oxygen, and so delicate are they that one part of oxygen in 143,000 parts (by volume) of inert gas will produce a luminescence visible to the naked eye.

Man Imitates Nature

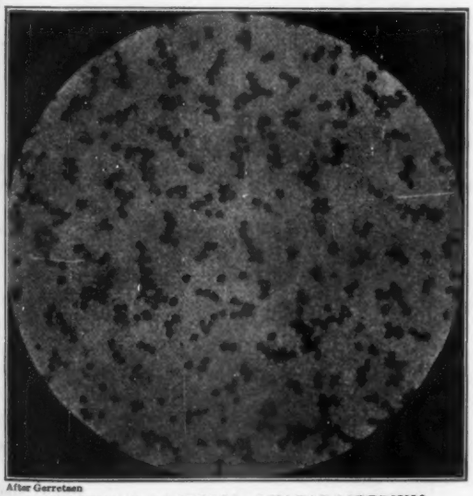
Who has not read loose statements that the firefly or other luminous forms of life generate light far more efficiently than man does in his power plants? Granting that the overall efficiency of the best incandescent lamp is only ½ of 1 percent, parallel calculations on "cold light" forms of life demonstrate that the overall efficiency of some forms, such as luminous bacteria, is only twice as great. Thus, we are within hailing distance of Nature already. So man, who occasionally likes to belittle his own achievements, has not done so badly after all. Probably he can do better. —*The Editor.*

* 1μ = .001 millimeter = about one twenty-five thousandth inch.

Sometimes luminous bacteria find a place to grow on living animals. The animal may be unharmed and live for days; or it may be injured and finally die. This is the case in a malady of sand-fleas sometimes observed along our coasts. The sand-fleas finally die, but while infected they are able to move like normal individuals, although as they jump about in the sea weed they are brightly luminous from the bacterial infection. If we did not know the origin of the light we might consider them self-luminous animals. The malady can be passed from one animal to another by inoculation. In fact it is quite possible to inject pure cultures of luminous bacteria into fish, squid, frogs, or other forms and make them luminous. The animal usually overcomes the infection but sometimes the bacteria live until they overcome their victim.

In a few instances animals are known which always contain luminous bacteria. A well authenticated case is that of two luminous fishes found in the Dutch East Indies, in the Banda Sea, which have developed a luminous organ designed for the support of luminous bacteria. Figure 4. The organ is large, just under the eye, and the bacteria are of a special kind which will not grow on ordinary culture media or on the outside of the fish. They are spoken of as "symbiotic luminous bacteria" and they present only another case of a mutual benefit partnership between two different organisms.

The fish have the benefit of the light while the bacteria are supplied with free board and lodging. Figure 5. A very rich system of blood capillaries brings food and oxygen so necessary for the luminescence of these bacteria. As it is characteristic of luminous bacteria that their light is shining day and night continually as long as they are alive, these fish have had to develop a screen to cut off the light, so we find a fold of black pigmented skin, like an eyelid, that can be drawn up over the luminous organ to observe the luminescence. Hence the name of the fish, *Photoblepharon*, or "light eyelid." The fishermen of Banda cut off these luminous organs, remove the screen, and impale them on hooks for bait. The light will shine steadily for a night's fishing. But *Photoblepharon* itself swims about in the sea, turning its great luminous organs on and off like many another fish that manufactures its own light material without relying on the kind assistance of luminous bacteria. Only a careful microscopic examination reveals the true nature of the luminescence of *Photoblepharon*.



After Gerretsen

LUMINOUS BACTERIA, *PHOTOBACTERIUM JAVANENSE*

FIGURE 1: *Highly magnified. This is a different kind from that used by the author*

Luminous bacteria prefer a low temperature for growth and are sometimes found growing in refrigerators. They can live on meat or eggs or almost any material which is not markedly acid. Robert Boyle records no ill effects from eating meat brightly luminous with (as we now know) luminous bacteria.

PROFESSOR E. NEWTON HARVEY

Professor Harvey's researches include not only those on light production by animals but on the permeability of cells, rate of nerve impulse, and oxidation

It will thus be seen that luminous bacteria are quite ubiquitous. It is not surprising to find them connected with man himself. Before the days of aseptic and antiseptic surgery, wounds frequently became infected with luminous bacteria and glowed at night. The surgeons of that time believed that luminous wounds were more apt to heal properly than non-luminous ones. Perhaps there is some truth in this view. Since luminous bacteria are harmless non-pathogenic forms, it is possible that such forms might crowd out pathogenic bacteria which were striving to gain the ascendency on the wound.

How Efficient Is Cold Light?

In the older literature there is a case of luminous sweat and several cases of human urine, luminous when voided, are reported. If these observations are really true—and so far as I know they have not been confirmed in recent times—we may be dealing with luminous bacteria. Or there may be secreted some easily oxidizable substance that luminesces during its oxidation. Several such bodies are known in organic chemistry.

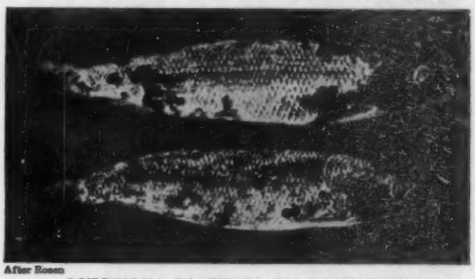
Luminous bacteria grow so easily in the laboratory that they are excellent forms for study, although not the best forms for certain phases of the subject. Thus, it has been shown that in some luminous animals two substances, in addition to water and oxygen, are necessary for luminescence—a discovery due to the French physiologist, Dubois, in 1887. He found that a luminous extract of an animal could be separated into two parts, one containing luciferin, which will oxidize with the production of light, and the other part containing a catalyst or enzyme which accelerates the oxidation of luciferin. The two substances could be separated by a difference in their properties, luciferase being destroyed on heating, while luciferin was not. We can obtain the two substances in solution in water, and they can be precipitated by various reagents. They can be purified and experimented with like any other bodies, although we do not know what is their exact structure. Chemically, luciferin is probably to be placed among the proteins, among the simplest members of the proteins, the peptones or proteoses; and luciferase is related to the albumins.

The presence of luciferin and luciferase cannot be demonstrated in luminous bacteria, although it is very likely that they exist and experimental difficulties prevent their demonstration. We are surely justified in speaking of the oxidizable photogenic material in the bacteria as luciferin and we may now ask how economical a process this oxidation of luciferin is. What is the efficiency of a luminous organism, regarded as a light-producing machine?

First it must be fully understood what is meant by efficiency in the case of illuminants. When an incandescent electric lamp lights, coal is being burned in some power house. Some energy is lost in generation of current, as only about 20 percent of the energy of the coal appears as electric energy at the lamp terminals. In the lamp, electric energy is converted into total radiant energy of all wavelengths (infra-red or heat, visible or light, and ultra-violet or chemical radiation) and this transformation may be very efficient in the case of a tungsten nitrogen filled lamp, about 95 percent. But the most wasteful transformation comes when we consider the proportion of visible radiation in the total radiation. The visible radiation is only three percent of the total radiation, and 97 percent is waste heat of no value for seeing things.

The "overall" efficiency is the product of all these efficiencies and represents the percent of energy in the coal which appears as visible light. For the best incandescent lamp it is about one half of one percent.

The energy of the coal is measured by the number of calories of heat produced when the coal is burned. As a pound of coal in burning uses up a very definite amount of oxygen, producing a definite amount of heat, we could calculate the energy of the coal in calories by measuring the oxygen it consumed in burning. Visible light or luminous radiation can also be expressed in calories.



After Rosen

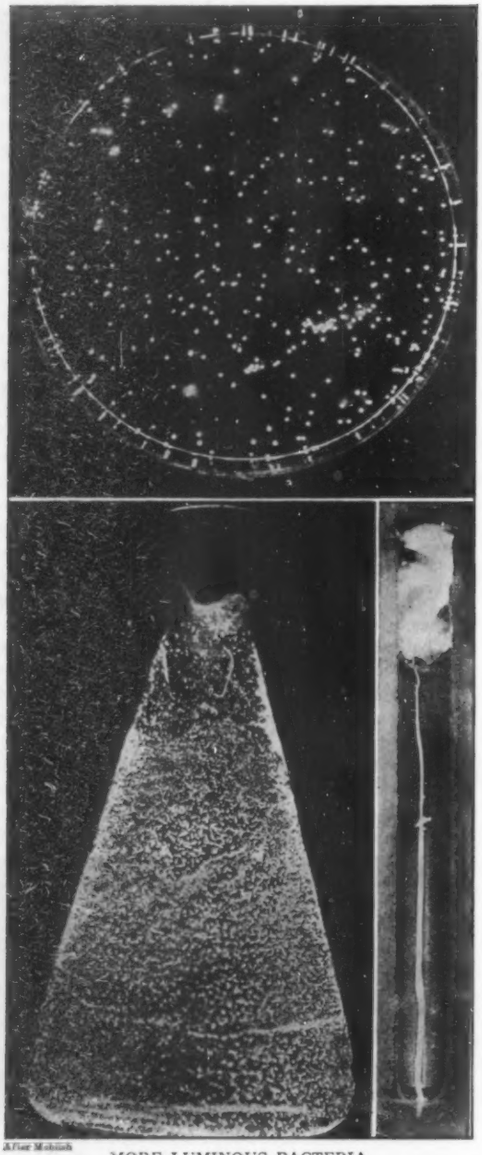
LUMINOUS BACTERIA ON DEAD FISH

FIGURE 2: *The whole fish shines in the dark. Placed in a vacuum (no oxygen) the glow ceases*

Let us now apply these facts to luminous animals, regarded as power plants for illumination. We must ask what fraction of the energy of the fuel (food) appears as light. No one has determined this for the firefly, and the investigation would present special difficulties because the firefly flashes, and flashing lights cannot be measured easily. We are forced to fall back on luminous bacteria which emit a steady light, despite the fact that they are the smallest luminescent creatures.

The percent of visible radiation in the total radiation of the firefly has been measured and is practically 100 percent since no infra-red or ultra-violet light is produced. The same would be true of luminous bacteria. On this fact is based the general statement that luminous animals are so efficient and economical. The statement refers only to their *luminous* efficiency and not to their efficiency as radiation producers. What we wish to know is the "overall" efficiency of the bacteria.

To obtain this we must measure the light produced by a single bacterium, and express this in calories per second. Food represents the source of



After Molisch

MORE LUMINOUS BACTERIA

FIGURE 3. TOP: *Growing on a culture medium.* BOTTOM: *In a flask or a test tube they glow like fire. The specks of light are each great numbers of bacteria*

an organism's energy, the energy input, and when burned, liberates a maximum amount of energy, which is also measured in calories. We must measure the food utilized by the bacterium and express the energy input in calories per second. Then, light emitted in calories divided by food oxidized in calories, gives us the overall efficiency of a bacterium.

The light measurements themselves present no particular difficulties. We can make an emulsion of luminous bacteria in sea-water, many billions of them, count the number of bacteria per cubic centimeter, measure the amount of light emitted by one cubic centimeter, measure the absorption of light by bacteria in front of others, and calculate the amount of light in "lumens" which each bacterium would emit in all directions, provided there were no absorption. As one candle emits four π lumens, the candle power of the smallest light in the world is easily obtained. It is about 20 quadrillionths of a candle for a luminous bacterium.

Just as we can measure the energy of coal by the oxygen it consumes in burning, so we can measure the energy of an animal's food, for instance sugar, from the total oxygen it consumes in burning the food. This is because of the equation:

$$C_6H_{12}O_6 + 6O_2 = 6CO_2 + 6H_2O + 677{,}200 \text{ gram-calories.}$$

Interpreted this means that a molecular weight in grams (180 grams) of sugar combine with six molecular weights in grams (192 grams) of oxygen to give a definite amount of carbon dioxide and water, with the liberation of 677,200 gram-calories of heat. One gram of oxygen burning sugar therefore represents the energy of 3,527 gram-calories.

Metabolism experiments in animals have actually shown that for a gram of oxygen consumed a certain number of calories is produced by oxidation of the foodstuffs, depending on the kind of food. A gram of tallow oxidized by a guinea-pig liberates the same amount of heat during combustion to CO_2 (carbon dioxide) and H_2O, as if it had been burned in a candle. This was one of Lavoisier's great contributions to science. A bacterium could obtain no more energy in burning its foodstuffs than a guinea-pig or any other organism.

Knowing the oxygen consumption of an animal and its food, we can calculate its heat production, and this "Method of Indirect Calorimetry" gives results which are in surprising agreement with direct measurement of heat production in a calorimeter. Applying this method to luminous bacteria, which were fed upon 60 percent glycerine and 40 percent peptone, we can calculate that each gram of oxygen consumed should produce 3,400 gram-calories or 3.4 gram-calories per milligram of oxygen consumed. In order to find how much energy is supplied by the food during luminescence, we have only to measure the oxygen consumed by the bacteria.

Can Man Outdo Nature?

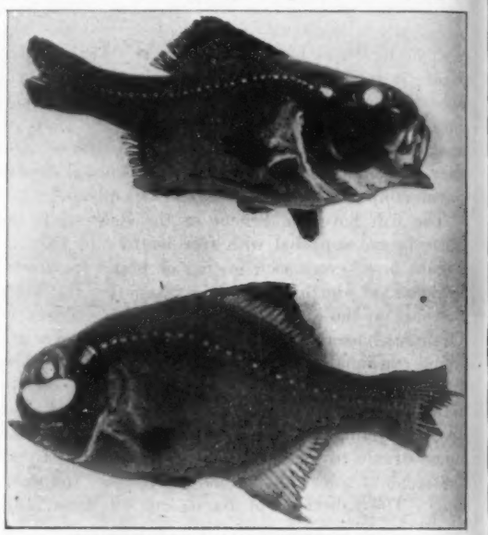
Converting energy from milligrams of oxygen utilized and lumens of light emitted into the same units—calories—the overall efficiency of a bacterium turns out to be 0.16 percent. This tells us the percentage of the energy necessary to run a bacterium, which appears as light. It does not give us a true picture of the efficiency of the light-producing reaction, for much of the oxygen consumed is used by bacteria for growth processes which have nothing to do with luminescence.

To continue our comparison of a bacterium with a power plant, it is as if the power plant had to enlarge itself at the same time that it generated electricity. The power plant is a stable unit, and in the comparing of a bacterium and a power plant it is hardly fair to count the energy used in growth as part of that necessary for light production. Unfortunately we do not know what percent of the oxygen consumed by a bacterium is used in growth or other processes. It can be shown by other experiments that certainly only one-sixth of the oxygen is used in luminescence, and probably very much less than this. Using the figure, one-sixth, brings the efficiency of the bacterium to nearly one percent (.16 percent $\times$ 6), a figure twice as great as that for overall efficiency of the best incandescent lamp.

Thus, even the smallest creatures can very efficiently carry out the most complicated processes. We can imagine the oxygen going in and can see the light coming out of a bacterium, the alpha and omega of luminescence.

What a marvelous spectacle the intermediary mechanism must present!

Magnify a bacterium ten million diameters. It would be 22 meters (about 75 feet) long. Oxygen and water molecules would be three or four millimeters in diameter. We should see the atoms in all their complicated movements and positions. We should see how the outer surface of the bacterium acts as a selective membrane, letting some molecules through and keeping others back. We might feel the oxygen molecules rushing in, 215,000 of them entering every second by actual count. Or we might feel carbon dioxide molecules rushing out, even more of them, the great vital wind of respiration, common to all living things. Inside would be catalytic surfaces, their molecules arranged in a definite way, changing and yet unchanged. For modern ideas of molecular structure are not mere



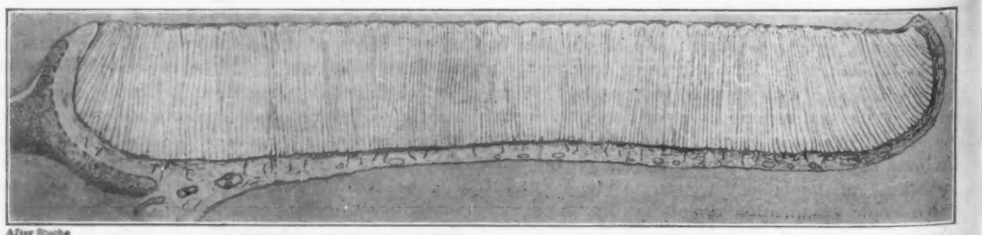
PHOTOBLEPHARON, BANDA ISLANDS

FIGURE 4: *Its luminous organ contains symbiotic luminous bacteria. The organ shows, on the lower fish, as a white, oval mass under the eye. In the upper fish it is concealed by a fold of pigmented skin, like an eyelid*

figments of the imagination but represent something real. The molecules of a film of oil on water are known to stand side by side, their feet entangled in, their heads above the water.

If our time sense were properly altered, we might observe the light emitted in pulses or quanta, 1,280 from each bacterium every second, by actual measurement. If, as the measurements indicate, 215,000 molecules of oxygen are absorbed and 1,280 quanta emitted every second, it would take 168 oxygen molecules to produce a quantum of light. If so we should be justified in saying that only 1/168 of the oxygen absorbed was used in luminescence. This would make the overall efficiency of a bacterium very high indeed, perhaps 25 percent.

Here is a line of inquiry for future study, that involves research of fascinating interest and which may lead to matters of great practical importance.

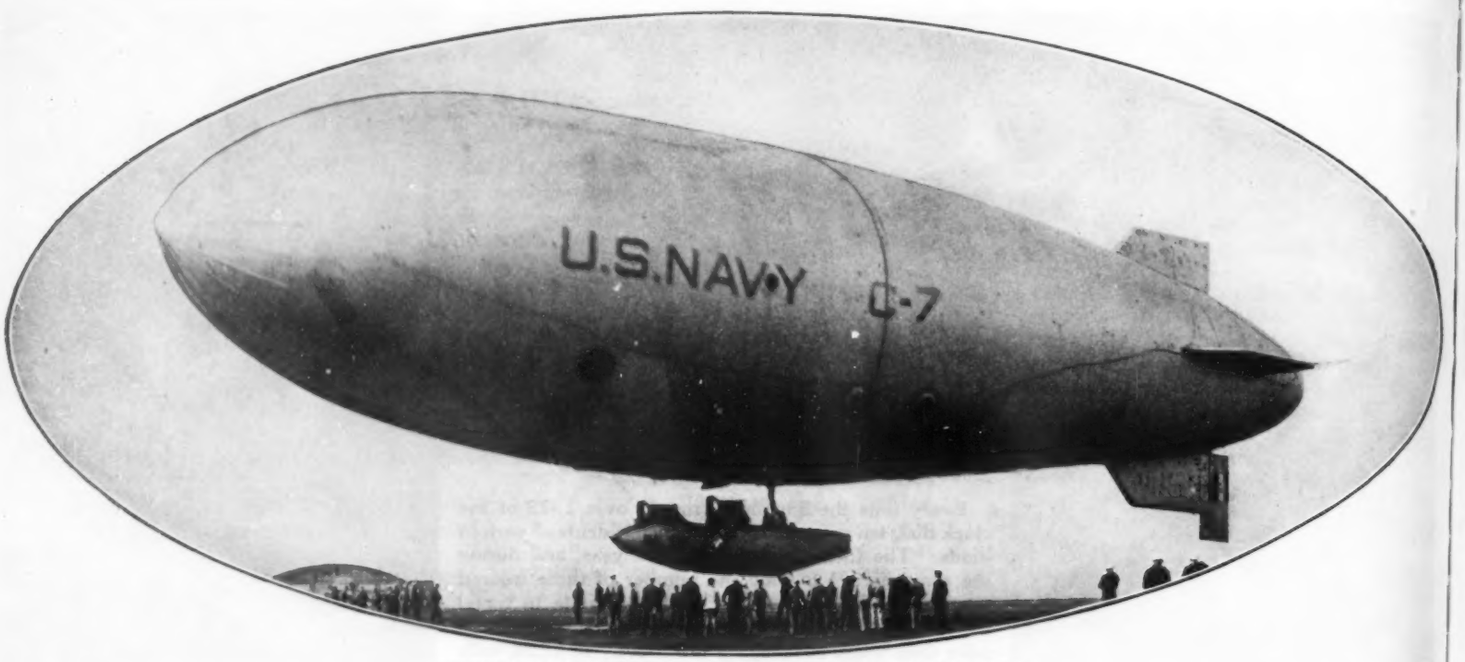


After Roche

SECTION OF THE LUMINOUS ORGAN SHOWN IN FIGURE 4

FIGURE 5: *This shows the tubes of nutrient material which contain the luminous bacteria. These organs are used for bait in Banda (Dutch East Indies) by the fisherman, as they will continue to shine for a whole night's fishing*

AEROPLANE TRAVEL
OUT OF 48,904 PERSONS CARRIED 2 WILL BE KILLED.
PERSONS CARRIED TO EACH FATALITY 24,452
WILL YOU TRAVEL SAFELY IN THE UNITED STATES ?
Every time the hour hand moves over 1/12 of the clock dial, ten persons are killed by accidents of various kinds. The total exceeds 85,000 a year, and during the same period of time the number of those injured runs into the millions. But do not hesitate to travel for you will be as safe as in your own home and much safer than when strolling on the street. In 1924, only a few more than 2,000 persons perished in railroad, street car, steamboat and airplane accidents. Our artist has drawn an interesting comparison of the hazards of travel in public conveyances which gives much food for comforting thought. We would like to have included figures of bus and taxi travel but this is impossible. While we are able to get such figures for individual cities and even whole states, the entire country cannot be covered owing to the lack of uniform accident reporting, and because of the incomplete records of the number of passengers carried. We have consulted the foremost statisticians relative to this matter and they all consider that this problem is insoluble. It must not be supposed that the record of safety in public travel was made without great effort in which the companies, the regulating authorities and the public have all co-operated. We shudder at railroad accidents. They often claim many victims, but consider the number of passengers that are carried safely. Street railways cause many accidents but again, regard the immense number of passengers transported. Our steamship figures are strictly limited to coastwise, lake and river traffic of the United States, but the fatalities during transatlantic travel are also low. Falls, burns, drownings, et cetera, due to accidents during transportation, must also be considered, but when all the data are at hand, travel is found to be safe when compared with every-day pursuits in which we are exposed to many dangers.
RAILROAD TRAVEL
149 WILL BE KILLED.
PERSONS CARRIED TO EACH FATALITY 6,313,800
COASTWISE, LAKE, RIVER STEAMSHIP TRAVEL
OUT OF 322,565,379 PERSONS CARRIED
54 WILL BE KILLED.
PERSONS CARRIED TO EACH FATALITY 5,973,436
LOCAL AND INTERURBAN RY.
ELECTRIC RAILWAY, SUBWAY TRAVEL
OUT OF 15,750,000,000 PERSONS CARRIED 1870 WILL BE KILLED. PERSONS CARRIED TO EACH FATALITY 8,422,460
BUS, TAXI, JITNEY TRAVEL
WHEN THE ENORMOUS PASSENGER TRAFFIC IS CONSIDERED WHO CAN TELL HOW MANY PEOPLE ARE CARRIED OR WHAT ARE THE FATALITIES ?



AIRSHIP "C-7" FITTED WITH PRESSURE-RECORDING APPARATUS

To determine exactly the air pressures, positive and negative, which act upon the surface of an airship in flight, the Navy Department inserted numerous pressure disks in the skin of C-7 and connected them with recording apparatus within the ship

New 6,000,000 Cubic-foot Airships for Our Navy

These Ships, Specially Designed for Helium Inflation, Will Have the Motors Mounted Internally, Thereby Reducing Head-resistance

By C. P. Burgess
Bureau of Aeronautics

A BILL providing for a five-year program of construction of naval aircraft, including two giant airships, each of 6,000,000 cubic feet volume, was passed at the last session of Congress, and signed by the President. Contrary to the general belief, the bill appropriated no money, so that the realization of this important addition to our air force still awaits the action of Congress.

The two airships are by far the largest units in the new program; and surely it is not too much to say that these marvelous structures, larger than the *Leviathan*, and of less mean density than air, are also the most interesting feature.

Stubbier Ship Provides Greater Strength

The Bureau of Aeronautics has prepared for the authorization of these giant airships by carrying out, on the *Los Angeles* and smaller airships, extensive experimental work of great importance, and has proceeded with design calculations as far as practicable with the limited funds available, so as to be in a position to proceed with the details of the design when the word "Go" is received from Congress.

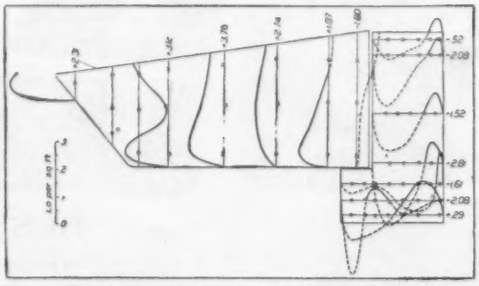
The new airships will each be more than twice the volume of the *Los Angeles* and the ill-fated *Shenandoah*, but relatively short and stout, as shown by the following table of dimensions:

Airship	*Shenandoah*	*Los Angeles*	Proposed
Volume, cubic feet....	2,150,000	2,600,000	6,500,000
Length, feet	680	658	780
Maximum diameter, feet	78.7	90.7	135

Note:—Dimensions of proposed ship are approximate only.

The more buxom shape of the new airships not only provides greater strength than the slender form of the *Shenandoah*, but also gives less resistance by reducing the surface for friction to act upon. It may be asked why the process of reducing the ratio of length to diameter is not carried further if it is so advantageous. The answer is that the Bureau believes a length of about five to six times the diameter gives the best efficiency in regard to both weight and resistance. With a shorter and fatter ship, the increasing weight of the transverse frame outweighs the saving in the longitudinal structure; and the increased form resistance overbalances the saving in frictional resistance.

The Bureau of Aeronautics intends that these airships shall be the most efficient naval airships yet constructed in any country. They will be the first airships specially designed for inflation with helium. This gas has hitherto been used only in airships designed for hydrogen inflation. A unique feature which is being considered is the placing of the engines within the hull, instead of in cars suspended outside. The interior positions of the engines will greatly reduce resistance, and give better protection to the personnel. It is a remarkable fact that even after the *Shenandoah* broke in two, not a man who remained within either of the separated parts of the hull was hurt. With hydrogen, the engines were necessarily placed outside the hull to reduce the fire hazard; but this danger is eliminated by the use of helium.



PRESSURES ON FIN AND RUDDER

This diagram shows, in full outer lines, the profile of the lower fin of the naval airship C-7 (see photograph above). The small circles are pressure disks. The heavy lines show the amount of pressures recorded during a circling flight. Full lines show positive, dotted lines, negative pressures

New Ships to Be Heavily Armored

It is proposed to carry an unprecedentedly large armament of machine guns for repelling airplane attack from all angles. The ships will also have provision for carrying their own fighting airplanes for further protection against enemy airplane attack. A large airship of this type has been designed by the Goodyear-Zeppelin Corporation. The number of machine guns carried is large. The system of propulsion is by engines within the hull, driving transverse shafts with bevel gears to the propellers supported on brackets.

Another Goodyear-Zeppelin design shows the new type of deep ring main frames, which it is proposed to use in place of the shallow frames with a mesh of cross-wiring, hitherto depended on for transverse strength in rigid airships. The ship was intended for passenger service, and the two internal longitudinal corridors with the passenger accommodations at the sides of the ship are interesting features.

The preliminary design calculations for the two navy ships have been based mainly upon a conser-

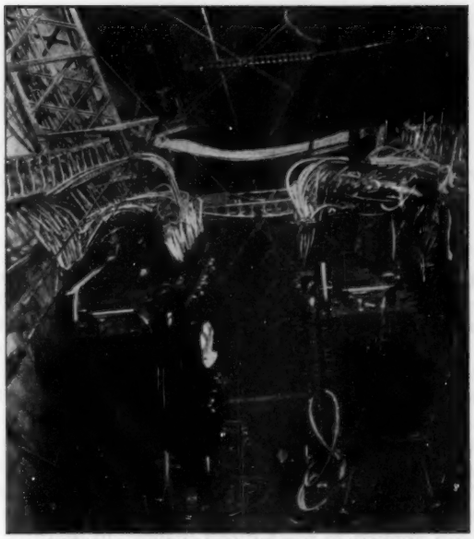
tive development of the Zeppelin type of rigid airship; but the Bureau of Aeronautics intends to invite other aircraft designers and builders to submit their ideas for consideration, so that the final design will be the fruit of the most expert engineering and aeronautical skill which America can produce.

Few people realize the extraordinary strength of the hull of a modern rigid airship in proportion to its great size and marvelously small weight. There is a very general impression that because the airship has no trussing through its center, it does not utilize its great depth to gain girder strength and stiffness. This is a wholly erroneous view. The truth is that the entire complex structure of longitudinal girders and transverse rings with diagonal wire bracing between the longitudinal and transverse members behaves in bending very nearly as a homogeneous tube.

Diagnosing Pressures on Airships

The researches of the Bureau have included most elaborate series of tests with specially devised instruments to determine the actual air forces acting upon airships in flight, and the resulting stresses in the girders. The investigations into the external air forces have been carried out mainly by the National Advisory Committee for Aeronautics on the Navy's rigid airship *Los Angeles*, and the small non-rigid airship *C-7*. The method of investigation was to transmit the air-pressure at different points of the surface of the hull, fins, and rudders through quarter-inch aluminum tubing to apparatus constructed to record photographically the pressure transmitted by each line of tubing. Many thousands of feet of tubing were installed in the *Los Angeles* for these tests last spring. Two of the recorders in the lower fin of the *Los Angeles*, and the tubes leading to them are shown in one of our illustrations.

Our illustrations include exterior views of the installation on the *C-7*, and a model of the hull of the *C-7* with the pressures along certain meridian lines represented by ridges, of depth proportional to the pressure. At the extreme bow the pressure is positive, changing to negative slightly aft of the bow, and remaining negative all along the hull to near the stern where there is again a region of positive pressure, but not nearly so large as at the bow. In the model, the ridges representing positive pressure are red, and those representing negative pressure are blue. These regions of positive pressure at the bow and stern, and negative pressure or suction along the middle body correspond to the crests of the wake waves which may be seen at the bow and stern of a steamship, and to the hollow along the middle. A moment's thought will make clear that the crest of a wave means more than normal pressure on the hull, and the hollow means sub-normal pressure, or, in other words, what is called suction.



VIEW IN LOWER FIN OF "LOS ANGELES"

Los Angeles, 658 feet long, 90.7 feet diameter, with a volume of 2,600,000 cubic feet, has been elaborately tested to determine the exact stresses to which she is subjected in flight. Pressure disks and strain gages are connected with these recording apparatus within the fin

The investigation with strain gages into structural stresses was carried out by the Bureau on the *Shenandoah* and the *Los Angeles* with instruments devised and constructed by the Bureau of Standards. Reduced to their simplest terms, the strain gages consist of 36 elements, each about eight inches long and clamped at its ends to a girder where the strain is to be investigated. The infinitesimal changes of length of the girder within the eight-inch gage length due to varying loads are sufficient to change the electrical resistance of a series of carbon piles inserted within the instrument; and each instrument is electrically connected through wires carrying a small current to a mirror galvanometer apparatus at the observer's station in the keel of the airship. The observer may note the simultaneous variations of strain in the selected girders in widely separated parts of the hull by watching the movements of narrow slits of light reflected from the galvanometers, and moving as the changing strains in the girders alter the resistances of the carbon piles. The positions of the lights are also photographically recorded on a moving roll of sensitized paper.

This apparatus has been used on many flights; and its records have been of immense value in developing our knowledge of airship strength. They have also shown the efficient working together of the various parts of the hull. The writer was observing the strain gages on the *Shenandoah* when local failure of the bow mooring gear caused her to tear away from her mast in a gale. The stresses in the hull had been high, but they at once fell to almost nothing as the ship drifted with the wind.

The experiments with apparatus for measuring the external forces on airships, and the resulting internal strains, have been carried out in such severe maneuvers and rough weather, without revealing dangerous forces, that it is certain that the squall which broke the *Shenandoah* must have been one of that type, which when they sweep along the surface of the earth in our mid-western states, uproot trees, overturn houses, and have even been known to carry away steel railroad bridges.

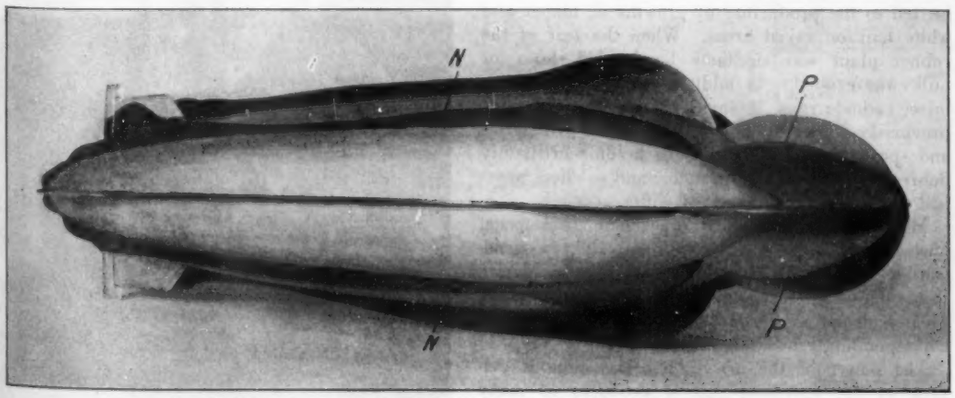
Rigid Ship Shows Steady Improvement

The *Shenandoah* was no stranger to squalls of very considerable violence. Her runaway flight in a gale when she was torn from her mast is well known. Much more severe air conditions, because more turbulent, were experienced on her famous voyage to the west coast. Here is an extract from the log of that voyage: "As the San Gregario Pass, leading to San Bernardino, was approached, the dissolving clouds showed the passage to be full of vertical currents, a really foreboding appearance, and the greatest difficulty was found in battling the strength of the wind rushing through the narrow opening between the two valleys." A few hours later the log records, "Heavy strato-cumulus clouds again developed and moved rapidly from the northwest and soon obscured the moon. In the darkness which resulted, a heavy squall cloud nearly reached the *Shenandoah* unobserved, but was seen in time to advise the elevator man to stand by for a heavy down gust. As the ship entered this cloud, she could be felt to descend much as an elevator, and at the same time, rain, sleet and snow were beating down upon her."

The new 6,000,000 cubic foot airships will be much stronger than the *Shenandoah*, and wild indeed must be the fury of the elements which can wreck them.

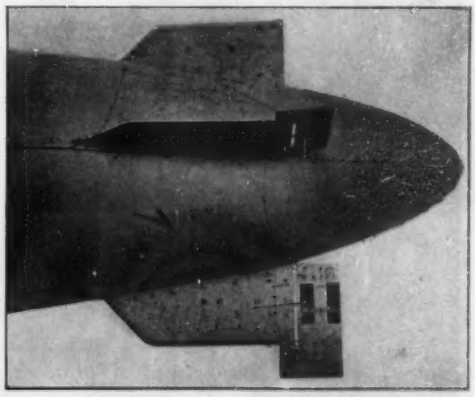
The rigid airship is the only type of aircraft which shows a steady and rapid improvement in performance with increasing dimensions. It is also the only aircraft which is truly habitable, and capable of operating at sea over vast distances and for days at a time through fog, storm, and darkness.

How truck wheels are made in a few crude operations from a steel I-beam is one of the interesting stories of industrial mechanics that will be dealt with in a forthcoming issue.



MODEL OF "C-7." RIDGES SHOW AMOUNT OF PRESSURE

At the bow, pressure "P" is positive and large. It changes to negative just aft of bow and is negative, "N," all along the hull to near the stern where it once more becomes positive. These positive pressures at bow and stern, and negative pressures along middle body correspond to bow, and stern waves of steamships in action and to the hollows along the midsections of the ships. It will be understood that the depth of the ridges, at any part of the hull, is exactly proportional to the air pressure at that point



STERN VIEW OF "C-7"

Dark spots on the fins and body are pressure diaphragms, whose pressures are recorded elsewhere for study by the observers stationed within the hull or control car. See photograph at the top of this page. By this means, pressures and stresses are accurately determined

A New Tool for the Research Scientist

Many Interesting Experiments Have Been Performed With the Improved Cathode-ray Tube. They May Lead to Discoveries Which May Be Even More Startling Than Those Made With X Rays

It is no longer a secret that when the remarkable phenomena produced by means of the newly developed tube described on these pages—especially its effects on small animals at short distances—were first observed, there was considerable fear among scientists that it would receive a bad dose of the wrong kind of initial publicity: it might be described by the sensational press as some new-fangled kind of "death-ray." No such purpose, it is almost needless to state, was in the minds of the scientists who developed it, and its effect on living matter is so comparatively limited in range that any such idea would be nonsensical.

As anyone may learn from any elementary physics text book, the cathode ray is not in itself a new thing—far from it. What Dr. Coolidge has done, essentially, is to modify the electron-discharge tube formerly used, in such a manner that the rays are powerful *outside*. As the accompanying article states, various interesting phenomena take place under the "super-cathode" rays but direct applications of practical value have not been announced as yet. It is significant, however, in view of this statement, that few have been the developments of this kind which have not soon been applied in some direct manner to industry and our daily lives.—*The Editor.*

CATHODE rays, or streams of high-speed electrons, were discovered by Crookes, an English scientist, in 1875, but their possibilities were limited because it was necessary to work within evacuated tubes. Hertz, in 1892, found that the cathode rays would go through metal foil placed in the vacuum tube. Lenard, his pupil, made a big step forward when, 30 years ago, he cemented a metal-foil window in the bulb of the tube and shot cathode rays through it, and thereby for the first time obtained cathode rays out in the air. Numerous advancements in cathode-ray tube construction have been made by other investigators since then, especially in regard to the output of the tube. In the research laboratory of the General Electric Company there has now been devised, by Dr. W. D. Coolidge, a tube which is characterized by greatly increased output, much higher operating voltages, and by being entirely sealed off from the exhaust system.

Practical applications for the new tube have not yet been developed, but its very high output has already led to the discoverey of phenomena which had not been observed with previous tubes. Such, for instance, are the production of a yellowish solid when cathode rays are passed through acetylene, a colorless gas; and the production of electrical discharges or explosions just beneath the surface layers of many substances. Work with a gray rabbit led to the production of growths of longer and white hair on rayed areas. When the leaf of the rubber plant was similarly bombarded, latex or milk was exuded. In addition to such results as these, cathode rays, in smaller concentrations, were previously found by other observers to kill germs and spores, cause many salts to become brilliantly fluorescent or to change in color, and to effect physical and chemical changes of different kinds.

Most of the effects are superficial phenomena, however, since the rays have relatively low penetrating power. At 350,000 volts they penetrate more than two feet of air, but in substances of greater density, such as salts, the penetration is correspondingly less.

The power of the new cathode-ray tube is evident in the statement that it produces as many cathode (or beta) rays as does a million grams of radium bromide, but of lower average velocity.

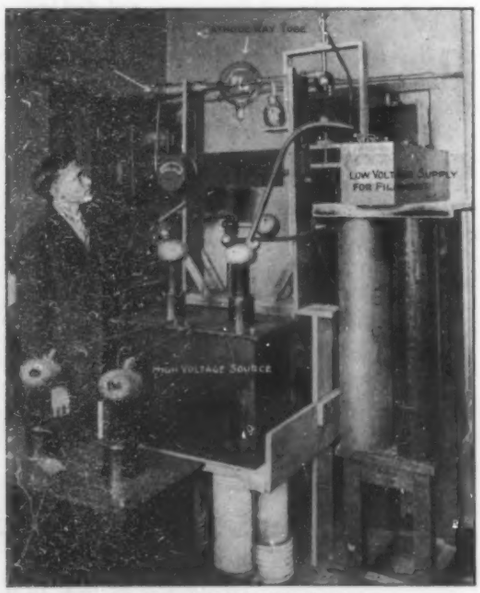
The window of Lenard's original cathode-ray tube was 1.7 millimeters in diameter, of aluminum foil 0.00265 millimeters thick, cemented to a metal plate in the end of the tube. The small diameter was the result of several circumstances. It was difficult to obtain a larger piece of such thin foil without minute holes, and it was difficult to support this thin piece of metal so that it would not collapse when the tube was evacuated. His tube was operated with a permanent connection to a vacuum system, and depended for its operation on the presence of a small amount of gas in the tube. The gas molecules were ionized when a high potential was impressed across the electrodes. The positive ions went to the cathode. The bombardment of the cathode by these positive ions liberated the electrons which constituted the main cathode-ray stream.

In the new tube a current of a few milliamperes, at voltages up to 350,000, may be used. The window has a diameter of eight centimeters, and is of nickel, 0.0254 millimeter in thickness.

The operation of the tube is similar to that of the modern pure electron-discharge X-ray tube, also a development of Dr. Coolidge's, in that the stream of electrons is liberated by a heated tungsten filament and in that a very high vacuum is

DR. W. D. COOLIDGE

Dr. Coolidge is Assistant Director of the great research laboratories of the General Electric Company and inventor of the powerful cathode-ray tube described on these pages



CATHODE-RAY APPARATUS

Voltages up to 350,000 and currents of a few milliamperes are used in the production of the extremely powerful ray which penetrates more than two feet of air

THE NEW COOLIDGE TUBE

The window, indicated at the left, is a sheet of nickel only 1/2,000 of an inch thick. Through it the rays emerge from the interior near-vacuum into the air

used. The tube may be sealed off from the exhaust system, and transported and used as easily as an X-ray tube. Connected to the window, or anode, there is a copper tube within the anode arm, serving as an electrostatic shield to prevent puncturing of the glass by the high voltage.

The cathode is a heated tungsten wire from which the electrons come; the anode is a nickel window which is half of a thousandth of an inch thick and which is supported against the atmospheric pressure by a honeycomb structure of molybdenum. Reckoned in inches, the window is thin, but in terms of atomic layers it is thick—500,000 atom layers deep. The window is soldered to an invar sleeve to which the glass of the anode arm is sealed.

The filament is heated with a low-voltage current. Electrons evaporate from the filament at a rate determined by the temperature, which in turn depends upon the filament current. A high voltage is impressed between the electrodes, the electrons from the filament thereby being driven at enormous speeds from the cathode to the anode, through which most of them go into the surrounding air.

Causes Minerals to Glow

The electrons escaping through the metal window cause the air to assume a purplish glow, extending in front of and for some distance back of the window. This luminous, essentially spherical mass may be as much as two feet in diameter, depending on the voltage, and is due to the ionization of the air by the high-speed electrons. The odor of ozone and the oxides of nitrogen is also noticeable. Impact of the electrons on the window causes a slight production of X rays there, and additional X rays are produced when the cathode rays impinge on other substances outside the tube. In addition to such phenomena as can be visually observed when a substance is placed in the path of the cathode rays, other things are happening. Matter of any kind in the path of the rays becomes heated by the bombardment of the rays and at the same time becomes a source of X rays, just as though it were within an evacuated tube. The general design of the new tube is such that it seems possible to use still larger windows and more energy.

The following experiments were conducted with a cathode-ray tube operating at 200,000 volts.

Calcite crystals, upon being rayed, glow strongly with an orange light and remain luminous for several hours. In addition to this, they may show

THE RAY-DISCHARGES IN AIR

The window of the tube shows dimly at the left. The luminous, purple discharge may reach two feet in diameter

bright, bluish-white scintillations. These have been observed while the crystal is undergoing bombardment and for as long as a minute after raying. By lightly scratching the rayed surface of the crystal with a sharp instrument, the scintillations may be induced for as long as an hour after raying.

The area in the neighborhood of a scintillation loses all of its luminosity as the scintillation occurs, and then appears dark against the bright orange background. Under the microscope the spot is marked by a little crater, with many tiny canals leading from it. Examination of one of these areas with a microscope shows the presence of a fine network of lines radiating from each explosion crater. Each appears to be a line of small globules, like a string of beads. The reason for this beaded appearance is not fully understood.

The luminosity of the ordinarily colorless and transparent calcite crystal is weird and uncanny. To the uninitiated the mineral has the appearance of a red-hot coal, and is touched with reluctance. It is cold light, however, in that no appreciable temperature rise is apparent, and the crystal can be handled without danger. The luminosity occurs within a very thin layer since the rays penetrate only about 1/10 millimeter into the crystal structure.

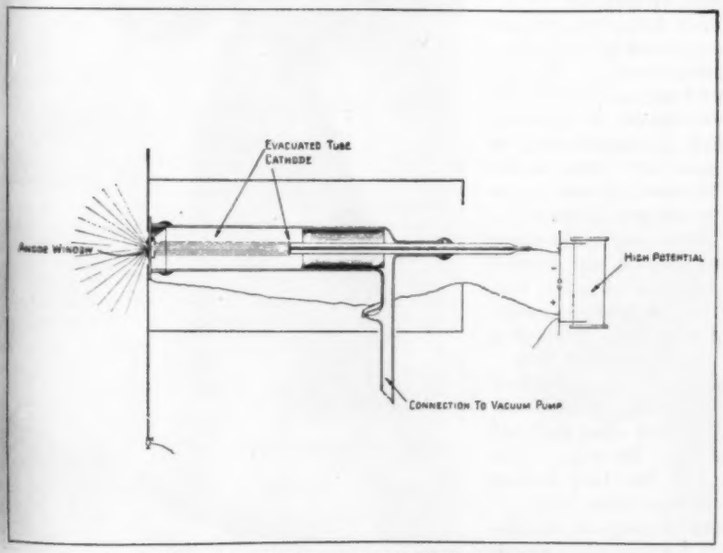
Calcite is not the only mineral which is caused to glow by treatment with cathode rays. Some glow only while subjected to bombardment, and others continue to glow for some time; and various colors are apparent, according to the minerals used. In the case of granite, a mixture of different minerals, a very beautiful effect is produced by the rays since such colors as orange, blue, red and green become evident. These colors are very brilliant while the granite is under bombardment, and persist less brilliantly for some time thereafter.

Intense Cold Works Weird Changes

Fluorescent screens such as are used with X rays are also caused to glow intensely when subjected to cathode rays. A beautiful experiment can be conducted with a fluorescent screen of cadmium tungstate. When subjected to cathode rays it gives off green light and shows very little phosphorescence, or afterglow. If a strip of this screen is dipped into liquid air and is then rayed, it shows, upon warming up, several distinct luminescent periods, each having its own characteristic color, the color depending upon the temperature. If, after the screen has somewhat warmed up and has passed through some of the colors, it is chilled again with liquid air and allowed to warm up once more, it will display no color until it has reached the previous higher temperature. The screen then glows with the proper color for that temperature. This radiant energy can be stored in the intensifying screen by maintaining a sufficiently low temperature, and can be liberated at any time by the application of heat.

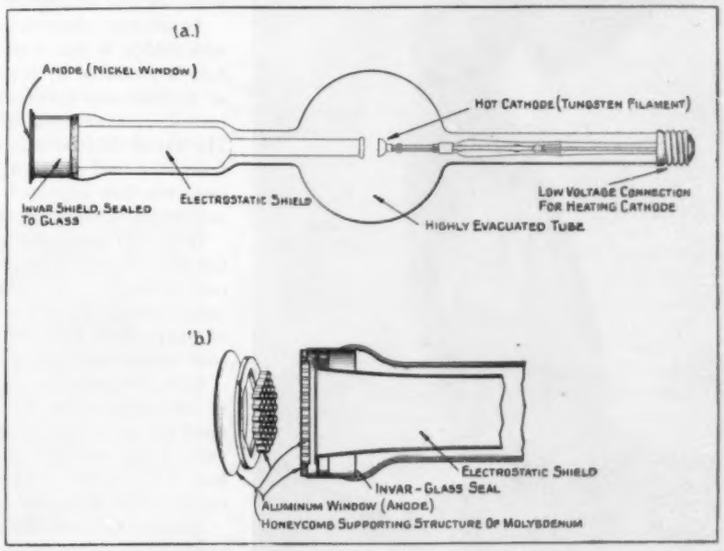
One of the most interesting experiments with the cathode ray has been the production of a solid by passing acetylene gas in front of the window of the tube while it is in operation. The product, similar to or perhaps the same as that obtained previously in minute traces either by a corona discharge in acetylene or by the use of radium emanation, has been produced in gram lots with the new tube.

In producing the compound, the gas is led through a chamber in front of the window of the tube, and the compound is formed immediately. It can be collected as a fluffy, yellow powder, or under different electrical conditions directly as a varnish-like film on metallic or other surfaces, to which it adheres tightly. The powder has been found to be insoluble in all the numerous chemical agents



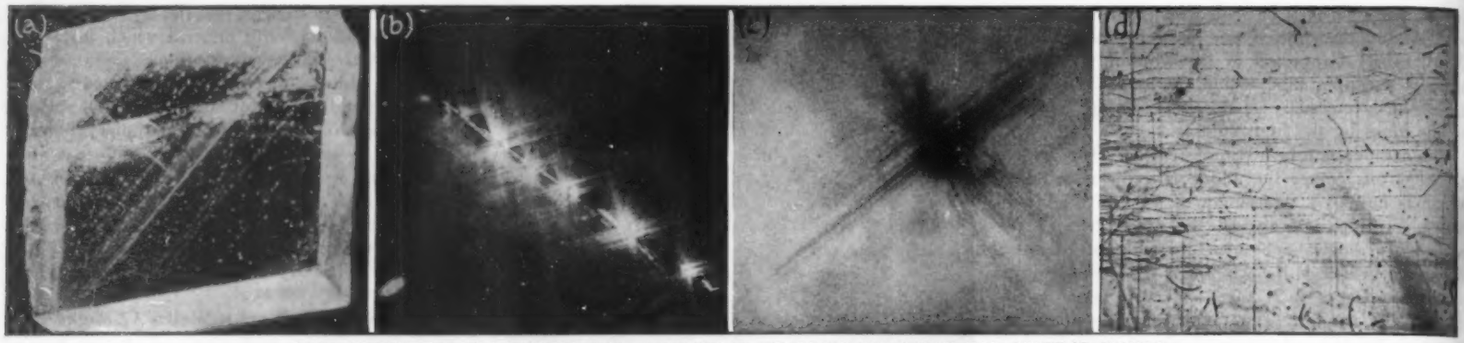
LENARD'S ORIGINAL CATHODE-RAY TUBE

By cementing a thin, metal-foil window to the end of the tube, Lenard passed the cathode rays out into the air. Cathode rays are free electrons moving at high velocities. When they strike anything, X rays, which are wave phenomena similar to light are produced



HOW THE NEW TUBE IS ASSEMBLED

The diagram and statements in the text explain this in detail. The use of the same word "rays" to denote both X rays and cathode rays is illogical in a sense and often causes confusion. As explained at the left, the two phenomena are in different causal categories



THE CATHODE RAY CAUSES CALCITE CRYSTALS TO GLOW STRONGLY FOR SEVERAL HOURS

Calcite is a common crystalline form of calcium carbonate, of which limestone and marble are another form. Under the cathode rays, these crystals scintillate with a bluish-white color in spots and emit orange light. At a, the spots which have scintillated show clearly on the crystal. At b, some of these scintillation spots are somewhat magnified. At c, a single spot is magnified still more, and shows the canals and crater. At d, under a magnification of 360 diameters a canal system shows as a string of globules

that have been tried so far in the experiments.

The high-speed electrons emitted by the tube cause many liquids and solids to undergo marked chemical changes. Just as acetylene is changed to a solid, so is castor oil solidified. Crystals of cane sugar become opaque white and, if heated afterwards, give off considerable quantities of gas. If a solution of sugar in water is exposed to the rays and then tested with litmus paper, it is found that the solution has become acid.

If a shallow dish of ordinary salt is exposed for a moment to the rays, the salt turns brown. By removing the surface layer of salt it is seen that the crystals beneath, not reached by the rays, have not been affected.

If glass is exposed to the rays, it immediately turns purplish or brownish in color, similar to the way glass is affected by long exposure to X rays. By the use of a metal stencil, the glass can be marked with any design, either very lightly or more deeply, depending upon the amount of exposure. Porcelain and crockery can be marked in a similar way.

The color effects produced by these experiments have been found to be more or less permanent. Some colors are lost in a short time, and others continue indefinitely.

Electrical discharges or explosions occur in a sheet of celluloid exposed to the rays at about liquid-air temperatures. These sparks or scintillations are observed in a dark room during and immediately following exposure. Subsequent observation of the celluloid under a microscope will show that just beneath the surface there has been a discharge where each of the sparks occurred. The craters in the celluloid are shown by a microscope not as straight lines of globules, as in the case of calcite, but as very irregular lines, due probably to the fact that calcite is crystalline in structure and celluloid is not.

If the leaf of a rubber plant *(Ficus elastica)* is pricked with a pin point, a white latex or milk is exuded from the puncture. When a portion of the leaf is rayed with one milliampere of current for 20 seconds at a distance of one inch from the window, the rayed area becomes covered immediately with the white latex, indicating that the electrons have in some way caused the cell walls to become permeable to the latex.

An exposure of only 0.1 milliampere for one second causes a color change in the leaf, with subsequent drying out of the rayed area to a depth corresponding to the penetration of the rays.

Rays Always Under Control

X rays do not kill bacteria, but the 200,000-volt cathode rays do, even with an exposure of as little as one-tenth of a second.

One milliampere of current for a fraction of a second has been found sufficient to cause immediate paralysis and subsequent death of fruit-flies.

A peculiar effect discovered during experiments with rabbits is that a profuse growth of snow-white hair is produced by exposure to the rays. The ear of a rabbit was rayed with 0.1 milliampere for 0.1 second over an area one centimeter in diameter. The rayed skin became deeply pigmented within a few days, and the hair came out. Seven weeks later, new hair appeared. This new hair was longer and was a mixture of white and gray in color.

With 100 times the exposure—one milliampere for one second on a similar area—a scab formed over the rayed area. The scab came off a few days later, taking the hair with it. A profuse growth of snow-white hair started two weeks later, and soon became much longer than the original hair.

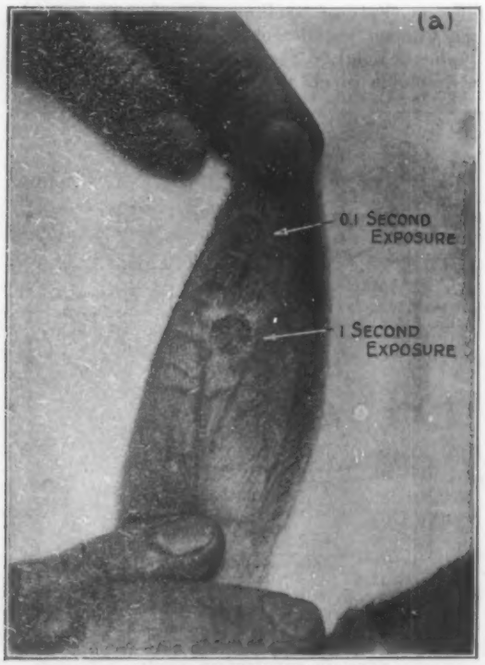
In further experiments the exposure was increased to one milliampere for 50 seconds. Scabs developed on both sides of the ear, and when they fell away a hole was left in the ear. The edge of this hole was at first without hair, but later became covered with a growth of the snow-white hair.

Among the most important of ray-producing devices or substances available for scientific research are radium compounds and similar products. They are constantly disintegrating and, in so doing, give off alpha, beta and gamma rays. The beta rays are really high-speed electrons, and in this respect are identical with those of the cathode-ray tube, but of higher average velocity.

Radium, however, is uncontrollable in that the experimenter cannot govern the velocity at which the electrons are bombarded into space. The cathode-ray tube offers a source of high-speed electrons, or beta rays, which is at all times under the control of the experimenter, both as to quantity and velocity. Added to this there is the fact that one of the tubes will produce a very high concentration of the rays—one tube releasing as many electrons per second as a million grams of radium bromide.

Much has been learned in the past of the properties of cathode rays by brilliant experiments conducted by numerous investigators. With the new tube—completely sealed, portable, always under control, capable of producing a very powerful stream of high-speed electrons—the field has been opened for conducting experiments previously impossible, and it is to be expected that our understanding of electronic phenomena will be greatly increased thereby.

Insects cost the United States two billion dollars a year! Rather expensive pests, to be sure, but the Government is combating them. Read of the fight and results in an early issue.



EFFECT ON RABBIT'S EAR

After exposure to cathode rays, over the two lengths of time indicated above, scabs formed but soon fell off, taking the old hair with them and leaving "bald spots"

SEVEN WEEKS LATER

The "bald spots" produced by exposure to the cathode rays are now covered with new hair. In one spot, it is gray and white and in the other, it is white

The Scientific American Sport-plane Trophy Race

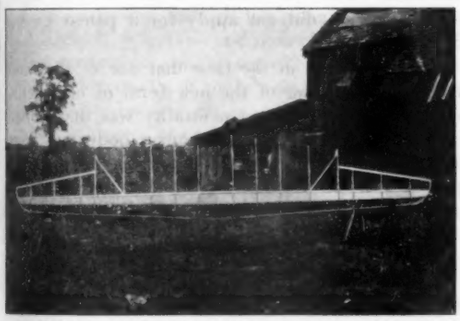
Extraordinary Speed Was Attained at the Philadelphia National Air Races

By Prof. Alexander Klemin

AT the National Air Races the classification of many events is based on the engine piston displacement measured in cubic inches, one cubic inch corresponding approximately to one-fourth of a horsepower. In the races for small engines the classifications ran under 510 cubic inches, under 300 cubic inches, and under 80 cubic inches engine displacement. With engines of the 80 cubic inch rating, possibilities are limited. It is doubtful whether a pilot and passenger can ever be carried with complete security by such an engine: certainly no very extended range is to be expected in addition to the carrying of two occupants.

The plane having an engine of 510 cubic inches and a horsepower of something around one hundred can hardly be considered a sport plane. Even if its initial cost is low, its fuel and other running expenses are likely to remove it from the popular sport-plane class. The Scientific American Trophy Race stipulated the intermediate value of under 300 cubic inches. We believe that this is a particularly useful rating, and that with engines of this displacement or a little under, the ideal sport planes for pilot and passenger will soon be developed.

In some respects the light plane race is the most interesting event of a National Air Race Week. The airplanes purchased by aerial service operators and by air transport companies are under continuous observation all the year round. Their performance and service characteristics are well known to all professional interests. However, the small planes are, at present, mainly in evidence only at races and therefore their design is always somewhat of a surprise. Their showing at the meets is their best selling argument. The one at Philadelphia was no exception, and the comparatively few light plane entries earned a disproportionate amount of the visitors' interest.



WING CONSTRUCTION OF THE WINNER

A single built-up box spar is employed, with veneer top and bottom but with fabric covering the rest

The small sport plane is not just an ordinary plane reduced in size. It has very definite characteristics of its own. It is particularly sensitive to control, and very maneuverable; its sensitivity may even be excessive and certainly no controls on the sport plane should be balanced. It has, as a rule, a lower landing speed and a correspondingly greater safety. When the heavily loaded transport ships crash, there may follow heavy damage and serious danger. The small planes inspire the greatest confidence by their ability to escape serious damage even under untoward circumstances. Further, by virtue of their smaller dimensions, when out of control as in a bad stall, they need a lesser height for recovery of normal flying attitude, a statement which the theory of dynamic similarity renders perfectly demonstrable.

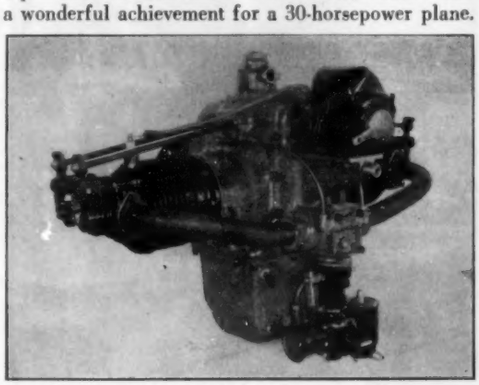
Their small dimensions, particularly when the wings can be folded, makes their housing and transportation to the flying field particularly easy. At the same time, they are real flying craft able to negotiate quite a fair distance under poor weather conditions. Thus, Jack Laass who piloted the Driggs *Dart* from Dayton, Ohio, to Philadelphia on a flight of some 400 miles, encountered rain, fog and mountains having peaks of 5,000 feet with fog-covered valleys, yet arrived without mishap. Not once had his faithful little motor missed, and not a drop of water had found its way into his cabin enclosed with pyralin.

A PRIZE WORTH STRIVING FOR

This illustration shows the design of the bronze plaque that was awarded in the light sport-plane race

Besides the requirement as to the 300 cubic inch engine displacement, the Scientific American Trophy contestants had to carry a minimum load of 170 pounds, exclusive of fuel, oil and water, a light pilot having to be compensated for by a sufficient quantity of ballast. They could be one or two seaters. The race to be run on Tuesday, September 7 (though actually delayed by rain) was to cover 60 miles, 12 times around a closed course of five miles, with three marking pylons. All contestants were to start from "at rest," with engines running.

The winning plane was designed by F. E. Seiler of the Kreider-Reisner Aircraft Company of Hagerstown, Maryland, and is an interesting example of the simplicity and efficiency which can be attained in the construction of these small planes. Piloted by A. H. Kreider, it averaged 94.5 miles per hour over the course, an extraordinary speed record for planes of this type in a closed circuit race. One lap of the race was timed at 99.4 miles, which seems a wonderful achievement for a 30-horsepower plane.



THE WRIGHT-MOREHOUSE ENGINE

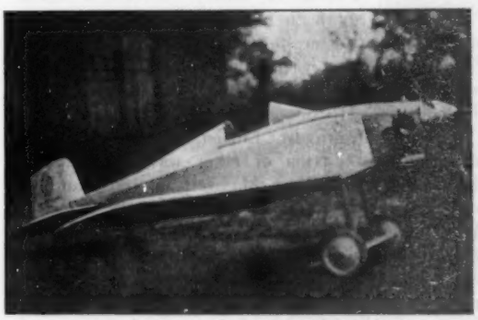
This type will drive a small plane at 90 miles per hour, consuming a gallon of fuel in about 36 miles

The M-6 wing curve, a double-cambered surface, proved quite efficient and its constant center of pressure (due to a reversed trailing edge) helped in the structural design. The 20-foot span wing is built very simply with one veneer-covered spar, the fabric covering terminating in a wire at the trailing edge.

The total area of the wings is only 60 square feet, and the over-all length is but 15 feet. The total weight fully loaded is only 490 pounds. The design of the plane is simplified also in the one piece horizontal tail surfaces, the elevator and stabilizer being combined. A wing surface of four square feet is attached to the axle and provides some lift as well as giving a streamline to the axle.

One interesting tendency is noticeable in the design of these light planes: the placing of the wing at the bottom of the fuselage and near to the ground, as in both the Kreider *Midget* and in the little Ford monoplane. Apparently designers like to get all the lift they can by placing the wing near the ground and so reducing both landing and get-away speed.

The second prize went to Heath of Chicago, flying the Heath *Tomboy*, with a very clean cantilever monoplane design, who averaged 91.2 miles per hour, using the Bristol Cherub engine. C. D. Chamberlain finished third with a two-seater of the vintage of 1920, and the Driggs *Dart*, likewise equipped with a Wright-Morehouse finished last with a speed of 85.4 miles per hour. It was perhaps handicapped by the long and difficult trip across the mountains, which we instanced as a proof of the rugged qualities of these light planes, and it was somewhat old in construction.

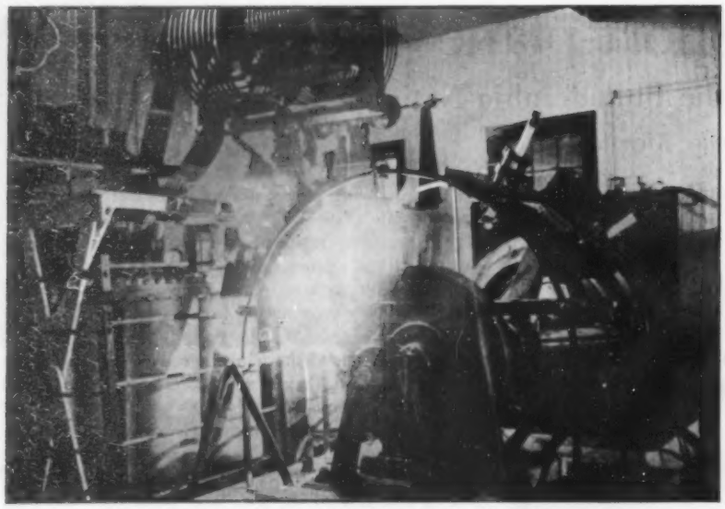


SIDE VIEW OF KREIDER "MIDGET"

The little craft is streamlined just like a racer, even to the pointed spinner on the propeller

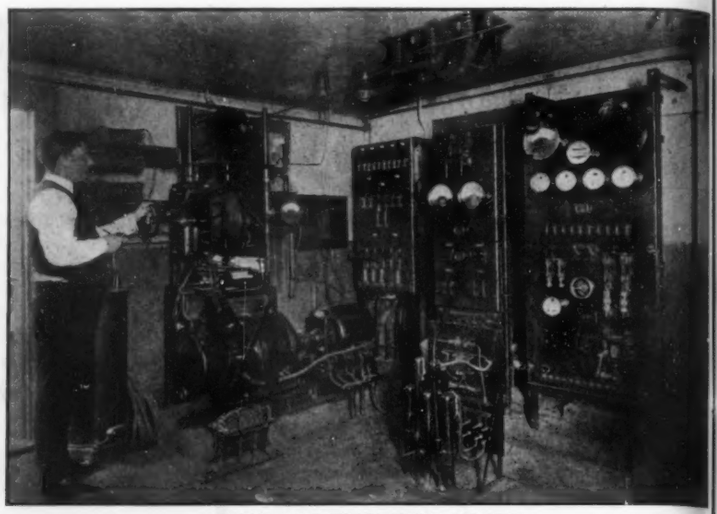
In previous air meets, plane designers of small craft have had to use either foreign-built engines or else motor-cycle engines adapted to plane use. It was gratifying to have the Scientific American Trophy carried off by an American-built plane with an American-built small engine. The Wright-Morehouse has two cylinders horizontally opposed. It is rugged, simple, well-balanced and reliable. With a bore of 3.75 inches, a stroke of 3.625 inches and a piston displacement of only 80 cubic inches it delivers 29 horsepower at 2,500 revolutions per minute. It weighs but 89.5 pounds. The fuel consumption is 2½ gallons per hour at full throttle.

The Wright-Morehouse actually showed up better in the race than the foreign-built Bristol Cherub, of similar power and design. In the various laps of the race, the Cherub missed a little in Heath's plane. The Wright-Morehouse never gave an indication of trouble.



WHEN RADIO WAS KNOWN AS WIRELESS

The old rotary gap of 1912 made a deafening crash as the sparks leaped between the electrodes. In those days it was the last word in wireless but today it is obsolete, having given way to the modern vacuum tube and the quenched gap



A CONTACT WITH SHIPS AT SEA

The obsolete set at Bush Terminal, Brooklyn, which lost its popularity when broadcast listeners complained of interference. The transmitter was tuned by the wheel and lever. A rotary gap is on the motor shaft and a quenched gap is on the floor

Edison Glimpsed At Radio in 1875

Scintillating Sparks Led to Discovery of "Etheric Force"

By Orrin E. Dunlap, Jr.

ON the evening of November 22, 1875, nineteen years before Marconi made his first transmitting and receiving set, Thomas A. Edison observed a strange spark in one of his experiments with a magnet, and after study he proposed the name of "etheric force" for the phenomenon. Edison described his discovery in the Scientific American, December 25, 1875.

This disclosure by Edison, together with the theoretical prediction of ether waves outlined by Professor James Clerk Maxwell in 1867, and the creation and detection of electromagnetic waves by Heinrich Hertz in 1886, were developments which helped Guglielmo Marconi to "stand the egg on end," as Sir William Preece referred to Marconi's triumph. However, as one writer has said, "Marconi's creation, like that of the poet who puts words of men in perfect lyric, was none the less brilliant and original."

How "Etheric Force" Was Discovered

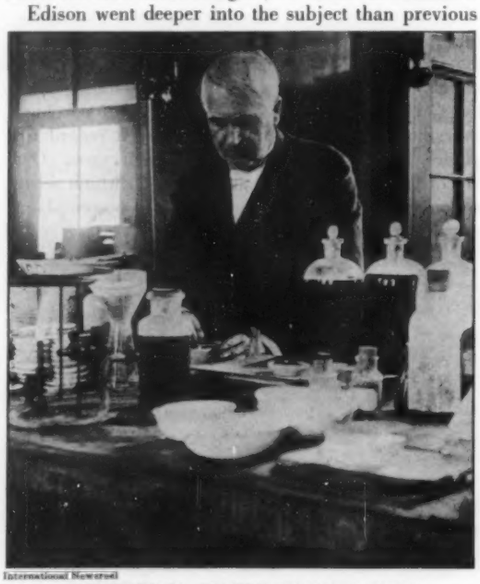
Edison first noticed the distinctive character of the "etheric" spark while experimenting with a vibrator consisting of a bar of Stubb's steel, fastened at one end and made to vibrate by means of a magnet. He and his associates observed a spark coming from the core of the magnet. They had often witnessed the same phenomenon in connection with telegraph relays when iron filings were between the armature and the core, but they had always supposed it to be caused by inductive electricity. On this occasion the spark was so bright that they suspected something more than induction.

Edison found that by touching any portion of the vibrator or magnet with a piece of metal, the spark was produced. The end of the vibrating rod was then connected by means of a wire to a gas pipe overhead, whereupon a spark could be drawn from any part of the gas pipe in the room. Subsequently it was found that a spark could be drawn from any part of the whole system of the city gas pipes. This indicated conclusively to Edison that a new force was at work which was not amenable to the laws of voltaic or static electricity.

Tested in various ways the new current refused to obey any of the established laws of electricity further than that it traversed metallic conductors. A lack of polarity was observed as one of its peculiarities. It was indifferent to the earth and consequently its capability of transmission through uninsulated wires and its independence of electric nonconductors was noted.

Previous to Edison's discovery it was accidentally found that when the contact of an electric current, which magnetized a large electromagnet, was broken very near one of the poles of the electromagnet, the spark was so much increased in intensity as to produce a powerful snap, like that of a pistol, while the breaking of the contact at a distance from the electromagnet did not produce such an effect. The next thing observed was the drawing of the sparks from the iron electromagnet, or from its armature.

Edison went deeper into the subject than previous experimenters, but if he had been more interested and had delved deeper into the mystery, radio broadcasting might have begun much earlier than 1920, and radio motion pictures might have been in vogue today. Edison did not apply for a patent on his discovery.



International Newsreel

THE FATHER OF THE VACUUM TUBE

Thomas A. Edison in his laboratory. He was the first to discover the electron discharge in a lamp

He pointed out at the time that one of the most remarkable features of the new form of electricity, which proved its perfect neutrality was that it had no apparent effect upon the human body and none on the most delicate of electric tests, the properly prepared frog's leg, unless an exceedingly strong galvanic current was used around the magnet.

Edison's Discovery Doubted

Edison conducted experiments to show that the new current differed from electricity, especially inductive electricity, in that its sparks were different in appearance and effect. The sparks scintillated. The current differed from electricity in general in its entire independence of polarity. It did not require a circuit nor did it require insulation. It would not charge a Leyden jar. It failed to affect chemical compounds sensitive to electricity, for example, iodide of potassium. It had no effect upon electroscopes or upon galvanometers. It was not felt by the tongue and caused no contraction in a sensitive galvanoscopic frog.

Little did the public realize fifty-one years ago that this strange spark might be the basis of a world-wide communication system destined to flash messages and entertainment to millions, simultaneously, at the speed of light, 186,000 miles a second. After reading Edison's announcement relative to the etheric force, one man wrote, "I cannot but believe that somebody is somewhere mistaken. Mr. Edison is perhaps sincere in his belief that he has discovered a new and valuable force; but he will soon learn that the hopes are delusive and evanescent."

In commenting upon the discovery the editor of the Scientific American in the January 1, 1876, issue said, "It is a new and distinct phase of force, an unstudied phase of electricity, which will rank Mr. Edison the most fortunate and eminent of scientific discoverers."

IT SOUNDED THE SPARK'S DOOM

John Frazier, outside pick-up engineer at station KDKA, holding one of the 10-kilowatt transmitting tubes used at the Pittsburgh station. The metal water-cooling jacket is at the base of the glass part of the tube

Some believed the new spark to be the result of induced electricity, but the electrical wizard proved that it was not inductive. In his test he used the following apparatus, with all parts insulated except the gas fixture: a battery, telegraph key, electromagnet, bar of cadmium, mirror galvanometer, gas pipe and a spark gap formed by two graphite points about the size of a lead pencil.

The unknown current was passed through the bar of cadmium and through the galvanometer without the slightest deflection, and nothwithstanding the gas pipe connection, which would drain the wire of induced electricity, if there were any, bright sparks were visible between the graphite points in response to the motion of the telegraph key.

Since that time, similar sparks leaping tiny metallic gaps have saved thousands of lives at sea, but today the more efficient and economical vacuum tube has replaced the old spark as a means of generating electrical oscillations to set the ether in vibration and so make wireless communication possible.

Edison's announcement spurred many others to experiment and try to produce the etheric force. All attempts to generate the force with a Holtz machine or Leyden jar were fruitless. It could only be produced by means of an interrupted current from several cells, using the vibrator magnet, or an electromagnet operated with a telegraph key and battery. Then the current followed the wire connected with the core of the magnet, or with a piece of metal within the magnet's sphere of influence.

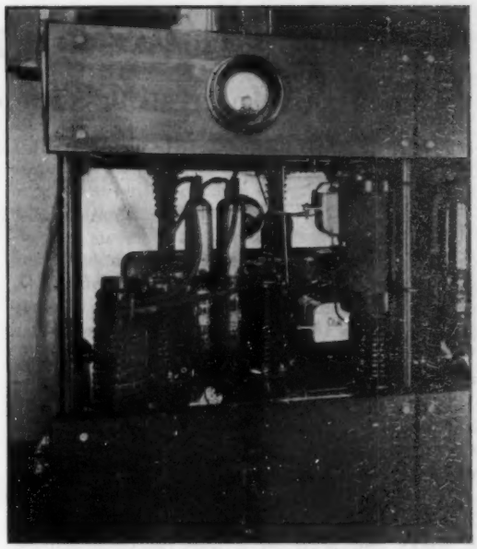
The force manifested itself as a spark when the wire was rubbed against a piece of metal; when a body of metal such as a gas pipe or stove was connected with the wire and touched by a piece of metal such as a knife blade, or when two carbon points were brought in contact within a darkened box, one carbon being connected with the wire leading to the magnet. The entire apparatus had to be carefully insulated to exclude inductive electricity. Sparks were also obtained when the conducting wire was rubbed by a piece of metal held in the hand, or even when the wire was rubbed by its own free end.

"Edison Effect" Applied to Radio

The conducting wire did not have to be insulated. It could be led through water, wound around large metallic bodies, or trailed along the ground, yet the scintillating sparks appeared. One rainy night Edison strung the wire from the vibrator out-of-doors across the sidewalk, up and down the block in the gutter, through which a torrent of water was flowing, thence by an alley to the rear of his laboratory, where sparks were distinctly seen between the carbon points in the dark box. Those who watched the sparks caught just a glimpse of radio!

While experimenting with incandescent lamps in 1880, the curiosity of Edison was aroused by black deposits inside the glass bulb and a blue halo surrounding one of the legs of the carbon filament. He thought that the blackening of the glass might be caused by a molecular bombardment. He coated a lamp on the outside with tinfoil and found that when it was connected in series with a galvanometer and the positive terminal of the filament there was a current flowing across the gap between the filament and plate. He then placed a piece of platinum foil between the legs of the filament inside the bulb and the effect was greatly increased. The phenomenon was called the "Edison effect."

Thus it was Edison who first discovered that a glowing filament in a partial vacuum within a glass bulb not only shed light, but also a shower of electrons, tiny specks of negative electricity, so small that the most powerful microscope cannot detect them. These little particles of electricity have been described by one scientist who states that if a drop of water, which includes a great number of electrons, because of the hydrogen and oxygen within it, were magnified to the size of the earth each electron magnified in proportion would be about as large as a grain of sand. Nevertheless, these electrons are to the radio receiving set as blood is to the human system.



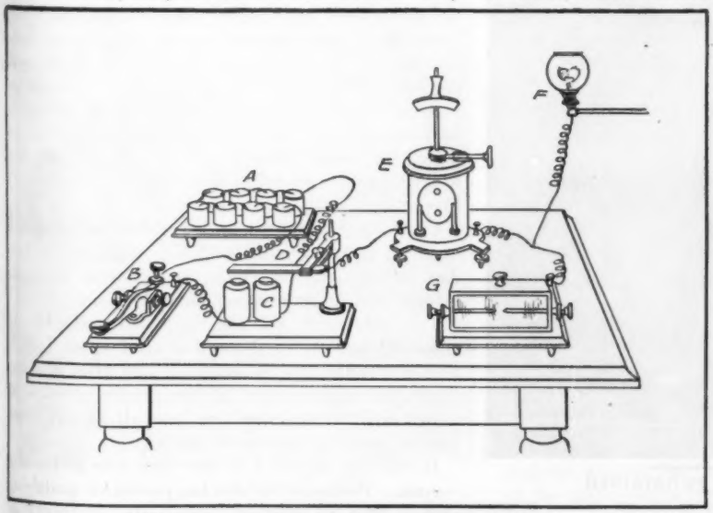
FIFTY-ONE YEARS LATER

A half-century after Edison's discovery of "etheric force" the spark is gone—replaced by the vacuum tube. This photograph shows eight of the 10-kilowatt water-cooled tubes at KDKA. Note the rubber hose for the water

Edison continued his experiments and invented the electric light but did not perfect the vacuum-tube detector and amplifier for radio, despite the fact that he had uncovered its basic principle.

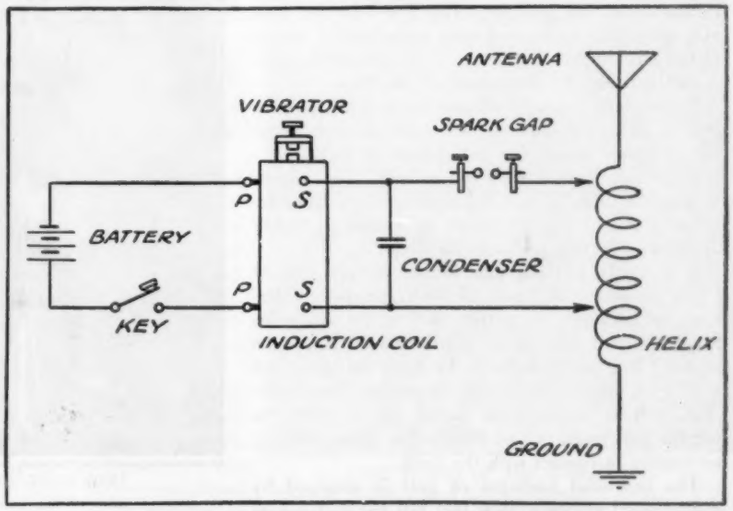
In 1904, Dr. James Ambrose Fleming, of England, introduced the Fleming valve and applied it to wireless reception. He installed a small metallic plate within the tube and connected it to the positive terminal of a high voltage battery so that a continuous stream of electrons would flow between the filament and plate. Since opposite electrical charges attract each other, the electrons, which are negative electricity, are attracted by the positive charge on the plate, forming a continuous stream between the filament and plate.

Dr. Lee de Forest in 1906 improved the Fleming valve by adding a third electrode called the "grid," making the tube more efficient and practical. He named it the "audion."



TESTING EQUIPMENT FOR "ETHERIC FORCE"

Edison's instruments, reprinted from the Scientific American of December 25, 1875, showing the layout used to produce and detect the strange sparks. "A" indicates batteries; "B," key; "C," magnets; "D," armature; "E," galvanometer; "G," gap; "F," gas fixture



ONE OF THE EARLY WIRELESS TRANSMITTERS

Amateur experimenters from 1905 to 1910 used this simple circuit to talk back and forth. Later, transformers were substituted for the spark coils and now vacuum tubes are the favorite means of generating current to set the ether in vibration

How Science Can Improve Your Golf

A Highly Interesting Article on the Reasons for the Vagaries of the Flight of Golf Balls that Was Prompted by a Former Article by Professor Sheldon

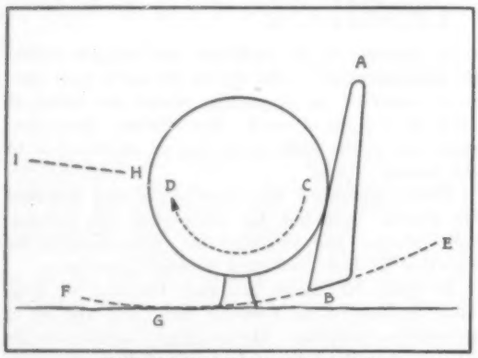
By P. A. Vaile

Author of "Swerve or the Flight of the Ball," "Modern Golf," "Modern Tennis," et cetera

IN a recent issue of the Scientific American, Professor H. H. Sheldon, Ph.D., Chairman of the Department of Physics, Washington Square College, New York University, writes in a very interesting manner of "The Physics of Golf Balls."

In dealing with the swerve of the ball Professor Sheldon says: "It may be asked, 'Why not use a smooth surface and thus largely avoid the spin which results in deviation?'"

My answers to that are: (1) A smooth golf ball is useless for golf because its flight is very erratic. It ducks and soars in a most uncomprehensible manner. Possibly Professor Sheldon, if he would devote his mind to this phenomenon, might be able to explain it. Professor Sir J. J. Thomson, the



HOW BACKSPIN IS PRODUCED

A downward glancing blow by the face of the golf club against the ball, causes the latter to spin in the direction of the curved arrow. In this drawing, "AB" represents the face of the club; "EF" indicates the arc of the club head during the stroke; "CD," the backspin produced by the downward glancing blow with either wood or iron club; "HI," the line of flight after the impact and "G," the point, where the club reaches the lowest point of the swing

renowned physicist, in a letter to me, confessed that he was unable to do so. I gave my explanation of the matter in the Scientific American some years ago, but I am always looking for further information on the subject. (2) The effective spin of a golf ball is affected very little by the nature of the marking of the cover. It is produced, practically entirely, by the nature of the blow.

To produce any appreciable amount of spin the club head, at the moment of impact, must be moving obliquely across the initial line of flight.

Professor Sheldon goes on to say: "The answer is that one form of spin, an underspin produced by hitting the ball slightly below the center, is highly desirable, for this prolongs its flight."

It is fairly obvious that hitting a ball slightly below its center will not, of itself, produce underspin, or backspin, as golfers call it, for, in order to get the ball into the air it must be hit below the center. Yet, many balls so hit have the slice and pull spin, which are totally dissimilar from backspin in their results, both in the air, or carry, to use the golf term, and in their action after pitching, or coming in contact with the earth.

The beneficial backspin of golf is obtained by a downward glancing blow that hits the ball before the club head has reached the lowest point in the arc of the stroke. To put it rather graphically, the spin in both golf and tennis is obtained by the striking implement brushing across the ball and thus causing it to roll on the face of the club or racket. To settle a controversy about the amount of roll of the tennis ball on the racket, in the American service, I had the strings of some rackets colored with lampblack and oil and allowed to dry. I then served the American service, using, of course, perfectly new balls, and obtained a perfect impression of what took place. Somebody will some day do the same thing in golf.

Professor Sheldon speaks of its being "sometimes desirable to use some slice or pull, thus obtaining the curved flight due largely to the effect of markings on the ball."

Why You Hook or Slice

As I have stated, the marking of the ball has little, if anything, to do with the production of spin. I cannot, indeed, see why it should be supposed to influence spin to any great degree, for the marking is of the same nature all over the ball, and, therefore, apart from adventitious air currents, one side should provide as much resistance as the other.

Professor Sheldon says: "The proper surface markings should obviously be those that will give the maximum effect due to spin, with a maximum of air resistance. At first it might seem that these two things would be the same, for the spin effect is, itself, due to air friction."

I maintain and have fully explained in my book "Swerve or the Flight of the Ball" that spin is mainly, in fact, almost entirely produced mechanically by the nature of the blow. I should feel very diffident in making this statement if it were merely my knowledge of physics against Professor Sheldon's for he has probably forgotten more about that than I shall ever learn, but this information comes to us from a physicist to whom the world bows, no less than Sir Isaac Newton.

All photographs posed by Bob MacDonald, professional golfer

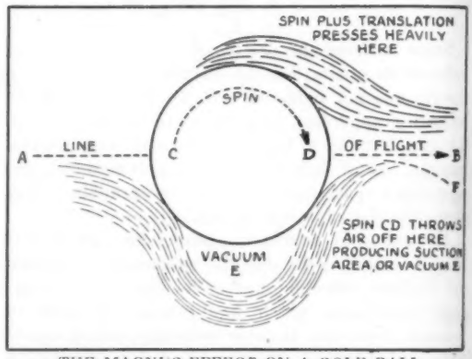
HOW BACKSPIN IS OBTAINED

A demonstration of the correct stance and address to use when it is desired to produce backspin. The hands are in front of the club head. This tends to make the lowest point of the arc come in after the ball is struck, thus producing a downward glancing blow. If the stroke is made properly, the ball will carry true

Writing to Oldenburg in 1671 about the dispersion of light, Newton said: "I remembered that I had often seen a tennis ball struck with an oblique racket describe such a curved line."

The great master physicist and mathematician had grasped the main principle, or one of them, correctly, for he then said "that the parts on that side where the motions conspire must press and beat the contiguous air more violently, and there excite a reluctancy and reaction of the air proportionately greater."

The very curious thing, however, is that Newton was wrong in his premises. To strike a golf or tennis ball with an oblique club or bat would push the ball away to one side or the other but would not impart much spin. The true cause of spin in



THE MAGNUS EFFECT ON A GOLF BALL

A combination of forces pulls the ball toward "F," as in the slice in golf. Turn this diagram upside down and put the page in a vertical position and you will have the explanation of the action of backspin. "AB" is then the line of flight; "CD," instead of sidespin, becomes backspin and the vacuum "E" is on top of the ball. As the spin is now fighting gravity directly, the curve toward "F" will be much less pronounced than in the case of sidespin

golf or tennis is now well recognized as coming not from an "oblique" instrument hitting the ball, but from the instrument hitting the ball *an oblique blow.*

Golfers will understand this clearly, for they know that a slice or cut is made by playing from the outside inwards across the line of flight, with the face of the club at a right angle to the line of flight at impact, whereas it would be disastrous to have the face of the club oblique to the line of flight, for unless the error were very slight, that would mean an annoying drive into the rough every time.

Professor Sheldon says: "It should be observed, however, that the velocity of any mark on the ball due to rotation may be quite different from its velocity due to translation through space."

This statement will be quite unintelligible to about 99 percent of those who read it, so I shall reduce it to the utmost simplicity and give, in a few words, the main reason for the swerve or curve of a golf ball, a tennis ball, a baseball or any other kind of spinning sphere in the air.

In quoting anyone I do not care ever to insert a comma. Professor Sheldon has placed his qualifying phrase "due to rotation" peculiarly, especially as it is not between commas. His statement should be: "It should be observed, however, that, due to rotation, the velocity of any mark on the ball may

be quite different from its velocity due to translation through space."

This is not scientifically accurate, for let us say, in backspin, if the mark happened to be on the axis of spin, the velocity of that point and the velocity of translation would be exactly the same. However, I understand exactly what Professor Sheldon means and I am now about to hand it on to you in a manner that means a few million arguments amongst those who own motor cars or play baseball, tennis or golf.

Very few people understand that the top of a wheel is moving faster through the air than the bottom. Please understand that I am putting Newton's discovery and Professor Sheldon's statement into popular form.

Try This Simple Test

I know that to many this will sound ridiculous so I shall suggest a simple proof. Put a plate, an ash tray or anything circular up against the wall or any vertical object on the table. Make two marks on the circumference of the circular object in a vertical line running through the center. Put a mark on the table or wall where the lower mark on the plate is. Do the same above the plate, so that all four marks are in the same vertical line. If you happen to be where other circular objects are scarce, a silver coin or anything that will take a mark will do.

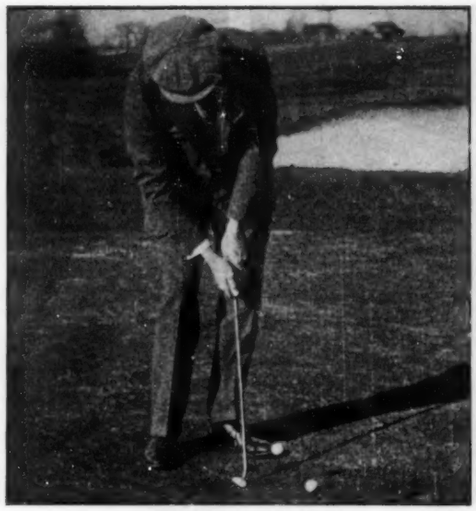
Now roll your plate forward about an eighth of the circle and, unless you know about this, you will be astonished to see that the marked spot on top of the wheel, has advanced six or eight times—I have never calculated it—as far as the spot on the bottom of the wheel. The marks on the vertical stationary object will serve as guides.

The simple explanation of this is that the axis of rotation is moving. If you jacked your car up and spun the wheel, all opposite parts would, of course, move through the air at the same rate. In the moving car, however, a point at the top of the wheel has the speed of progression of the vehicle plus the speed of forward rotation, while at the bottom we have a minus quantity in the backward rotation of the wheel.

Thus we find that our golf ball gets most friction on the side where forward spin and progression, or translation, agree. Following the well-known law that a projectile seeks the line of least resistance, the ball edges over to the non-resisting side,

THE START OF A LOW DRIVE

This interesting photograph was taken just after the impact between the head of the club and the ball. Notice how low the head of the club is kept and also the low flight of the ball. The streak of white in the lower right-hand corner of the picture is the ball in flight. The fan-shaped band is the club as it is carried through



PLAYING A STYMIE

The ball has just been struck and is in the air. Notice the shadow of the ball. The shadow of the club head proves conclusively that the head is in contact with the ground. This indicates the low finish of the stroke that produces backspin and which aids control of the run when making shots with an iron club

where the backward rotation is causing less friction. That briefly is the main cause of all deviation from the line of flight that is due to rotation.

There is another contributing cause that escaped the notice of even Newton and this will come as a revelation to sportsmen the world over, even to those who already know what I have just explained.

Most people have heard of Flettner's rotor boat, the sail-less boat that is propelled by objects that look like funnels. These are rotated by a small engine. The air rushes against them and they try to swerve just as a golf ball or a baseball does, but they cannot because they are attached to the boat, so they just push the boat along.

Something New in Ballistics

Flettner, in carrying out his invention, used what is called the Magnus effect. This was discovered, if I remember correctly, by Magnus in 1853. Magnus found that not only does one side of the funnel get pushed as we have seen, but he also discovered that there is a suctional effect on the opposite side, amounting to a semi-vacuum where the backward spinning side throws the air current off the cylinder. Thus it will be seen that the "swerve" of the funnels is caused by a push from behind and a pull from in front.

Now, instead of thinking of your funnel, or rotor, as vertical, consider it as a horizontal cylinder with backspin facing into a direct wind. You will now see that there is one force pushing it upward and another pulling it upward.

Forget that it is a cylinder and look endwise along it. You have now a diagram of a golf ball with backspin and the proof of something utterly new in ballistics, something that may increase your idea of the value of backspin, namely that above your golf ball is a suctional or lifting force, that, for all you know to the contrary, may be of greater importance than the well-recognized extra pressure on the lower side.

We have here, in effect, a force analogous to the area of negative pressure, or vacuum, on top of the wing of an airplane. Not many people know that the greater part of the lift is done by the top of the plane's wing, yet so it is. Sometimes almost 90 percent, and possibly more since I dabbled in aviation, is done by the top of the wing.

Here then is a revelation to sportsmen and something for the physicists to calculate, but, in order to do it successfully they must know golf as well as physics. Even so eminent a scientist as Sir J. J. Thomson fell into strange errors when he attempted to deal with the flight of the ball. He gravely stated that the beneficial backspin of golf was obtained by the loft of the club. Of course, if this were correct, we could just "angle" the faces of our clubs, hit a straight forward drive and get pulls or slices at will, according to the club we used, but, as we all know, that will not work in practical golf. He also stated that topspin in tennis was obtained by hitting the ball on top, which, of course, would merely drive it onto the ground or into the net. To get really correct information as regards the physics of golf, one must know the game.

Where Science and Practice Disagree

I have been very much interested by Professor Sheldon's work and now that I have pointed out this hitherto unsuspected force that is acting on all swerving balls, I am hoping that he will devote some attention to it and also add to, or correct, my explanation of the alleged mystery of the flight of the smooth ball, that utterly baffled Professor Thomson.

I notice that Professor Thomson has made experiments measuring the difference in pressure on the two sides of a spinning golf ball. He rotated the ball rapidly on a spindle, directing at it a blast of air, and found the pressure difference by means of a water manometer. This is interesting but here, again, Professor Thomson is falling into grave error from a golf point of view. He is assuming that the axis of rotation in the pull and slice are vertical, whereas they are not.

The axis of a sidespin such as slice and pull naturally approximates the angle of the loft of the club on which it "rolled" in order to get its spin and, in the slice, is slightly tilted back toward the player. In the pull the axis of rotation leans inwardly to the player at roughly an angle of 40 degrees. Their utterly dissimilar flight and run should be enough to put anyone on his guard against assuming, and even stating, as Professor Thomson does, that their axis of spin is vertical and that one is merely the converse of the other.

The problem of supplying water to the residents of Jerusalem is a great one, but modern engineering has come to the aid of the people. Read about this latest achievement in an early issue.

THE FINISH OF THE LOW DRIVE

The ball, traveling away from the camera, is shown in flight. In this photograph, the low finish and the pronounced downward tendency of the stroke is noticeable. The photographs on this and the opposite page, together with a careful study of the text will be of assistance to both the occasional and the consistent golfer

Brown Brothers

THE "SHIMMY" IN TOYLAND

All of the toys illustrated in the photograph are caused to execute a peculiar dance by means of a mechanically driven wheel that is mounted off-center

Brown Brothers

A TOY FISH THAT SWIMS

The "fish" shown above, both in the water and in the boy's hands, are cleverly articulated and can be made to swim through the water in a most life-like manner

The Development of Childrens' Toys

American-made Toys Have Ushered In a New Era of Instructive Recreation

By Elizabeth Banks

BEFORE the World War, the majority of toys sold in the United States were imported and those that were made here were mere by-products of other industries. Then the supply of foreign made toys decreased and American "big business" stepped in to provide the children of this country with playthings. So satisfactory were the results that the toys made here are now popular in other countries and the exporting of them has developed to a point where, for the first six months of 1925, the exports exceeded the imports.

One of the notable features of the growth of the toy industry in the United States is the increased demand for quality toys. No longer are our children satisfied with flimsy affairs that are very pretty to look at, but which soon fall apart. They demand toys that are sturdy and above all, lifelike. The toys must last, even when subjected to the hardest use. In order to meet this demand on the part of the children, American parents are now spending more money for toys than any other people in the world and are getting quality products. The result is that the toy industry in this country is growing by leaps and bounds and the children are getting what they want—toys that can really be played with, that are replicas of things used by grown-ups, and, more important to the parent, but little realized by the child, that are instructive.

Good Toys Must *Do* Something!

The child of today wants to be more than a mere audience with his or her toys. It is not sufficient to sit and watch the toy but there must be an element that allows the child to participate in the action and so, possibly, become an actor in some little drama of childish concoction. One outgrowth of this desire is the appearance on the market of toys that the child has to assemble. These take various forms, ranging from sets of wooden dowels and perforated disks to highly elaborate outfits which supply numbers of steel girders, bolts and nuts, I-beams, motors, gears and other items that lead the owners of the sets to attempt to duplicate, in miniature, the work of structural engineers. With toys of this type, the child not only amuses himself, but with the aid of a guiding hand and a few words from the parent, gains knowledge of a practical nature.

Every parent knows that boys like to make things. One answer to this urge is the mechanical toys just mentioned. There is also the boy who has the desire to make things from wood. Possibly this is one of the most instructive pastimes because the child must do all of the work himself, from the cutting of the raw stock to the finishing of the object. In this case the need for good toys is very strongly evident. One would hardly expect a carpenter to do work with a set of tools that cost a total of one dollar. How then, can a child, whose knowledge of carpentry is limited, learn to handle tools that will not do the work that is performed by good ones? It is far better to supply the child with a set of tools that are made of good materials and are duplicates of the father's tools in every way except size. Then, properly equipped, there is no reason why the boy should not learn the fundamentals of woodworking while he is at play. The constructive spirit of the child will ever come to the surface and if allowed full sway, may soon show tendencies that will reveal characteristics which may shape the child's future life.

Brown Brothers

A PRACTICAL TOY

This scroll saw, driven by an electric motor, can accomplish actual work with thin wood

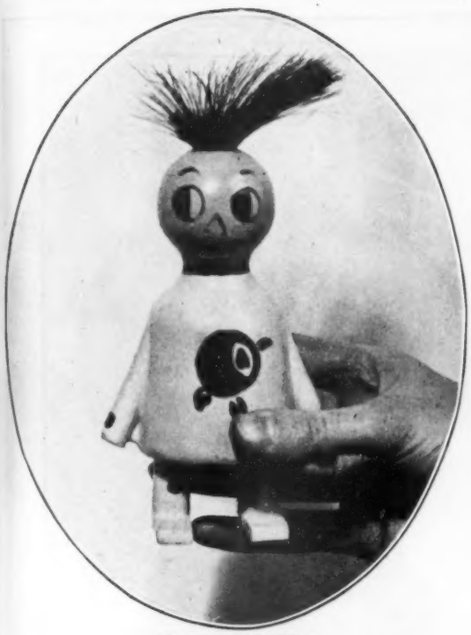
Another toy that demonstrates the mechanical trend is the complete machine shop shown in one of the illustrations on these pages. This arrangement is driven by a small electric motor and the toys so actuated operate in a surprisingly life-like manner. They can be used for light work. Then there is also the power-driven jig saw. With this, intricate patterns can be cut and the child can exercise his or her ingenuity in devising puzzles and so forth.

Toys That Have Personality

The psychological advantages of properly designed and constructed toys are not overlooked by our educators. They have made studies of play and its complement, toys, fitting the toy to the moral and social needs of the child of every age. Toys may be selected from carefully graded lists which they have compiled. For the age when the gratification of the child's sense of touch or hearing is all that is required of the toy, rattles, balls and other so-called "cradle-toys" are cited. For the "cuddling age," stuffed animals, such as the Teddy bear, the elephant, and soft-body dolls are recommended. So the lists go, through the period of the toy and into the "sports" age.

These lists are as useful to the retailer as to the parent, since they enable him to handle intelligently the request for a toy for a boy nine years old or for a girl five years old. They advise not only as to the general type of toy, but specifically as to size, color, and weight. They also take the season into consideration. As surely as spring brings the hurdy-gurdy, so it brings marbles and kites, so summer ushers in the toy sailing boats, and winter the sleds.

Our educators have further advocated that toys be bought in related units. The child shapes his games after the activities of his elders; his toys should have the same relation to one another as their originals in the adult world. Can a girl who



IS SHE SCARED?

This little doll, called "Scarey Ann" raises her hair when a lever in her back is pushed

has nine dolls but has neither a doll's bed nor a doll's chair play at keeping house? Shall a boy who has a horse and a sailing boat stage his play on the seashore or in the barnyard? Or perhaps he has a horse and a rooster for the barnyard, but the rooster is twice the size of the horse!

The value of toys in the physical development of the child has not been neglected. Indeed, the outdoor toy is almost exclusively an American creation. So obvious are the benefits derived from exercise toys designed for outdoor use that further comment is not necessary. As a nation we were sold on physical culture and outdoor recreation years ago. Recreational toys are more appreciated as our country villages grow into towns, and towns into cities, and as barns, fences, trees and cabbage patches give way to sidewalks and carefully tailored lawns.

Did the American toymaker sense the appeal which something new has to the average adult and make a bid for success on that score, or is he endowed by nature with inventive power superior to his competitors in foreign fields? Be that as it may, the American toymaker has put more new toys on the market in the ten years of his ascendancy than Europe ever dreamed of. He gives personality to his toys. The Teddy bear, although his pudgy figure was conceived in Germany, was given its name and popularized by an American, Seymour Eaton. Tommy Tinker and his associates are recognized joyously by the youngsters.

The American dolls have become known as character dolls. They illustrate particularly well the vigor with which the American manufacturer set about to capture the American toy market. The American doll had long been considered inferior to her German cousin, due to the fact that the making of the bisque head of the German doll baffled the American. Nothing daunted, he developed his doll with an unbreakable head and soft body, gave it character, made his appeal to the children who want their dolls as nearly like real babies as possible, and now the world clamors for the unbreakable "mama" doll. Raggedy Anne, Aunt Jemima, Rose O'Neil's Kewpies, and a host of cartoon character dolls, such as the Skeezix Boy, Little Orphan Annie, Felix the Cat, and Krazy Kat further illustrate this knack of the attachment of a personality to a product.

20,000,000 Dolls Annually

Indeed, the American doll industry warrants special mention, so amazing has been its development. Up to 1875, or just 50 years ago, there was not a doll factory in the United States. Today, the retail value of the products of the American doll factories is about 25,000,000 dollars annually. It is conceivable that the first doll made in this country is still treasured in a trunk of keepsakes in somebody's attic. If so, she should be feted on her fiftieth birthday! Imagination fails us when we try to picture such a party, realizing that her descendants are estimated at 20,000,000 dolls a year.

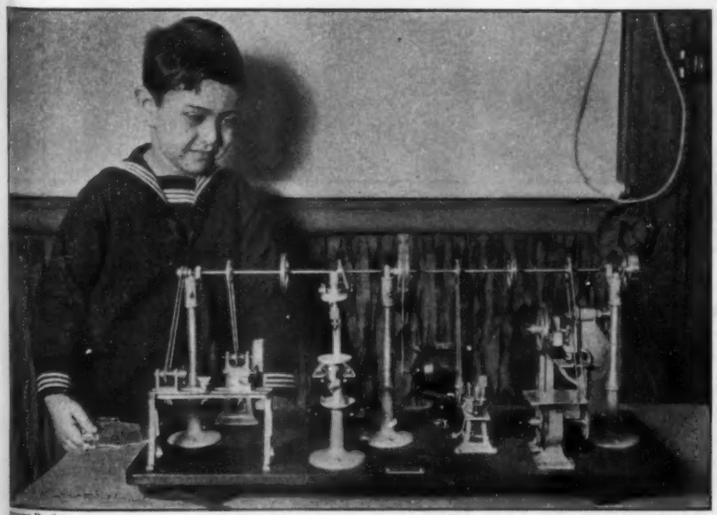
To put and keep good toys in the American home has been the honest aim of widely differing types of persons. Educators have given their best. Our penmen have contributed much, particularly to the individuality of the American toy. Progressive manufacturers have been receptive to ideas to be garnered from both these sources; they have kept their toys up to date and truly representative of the age in which we are living. Toy airplanes, toy submarines, toy vacuum cleaners, replicas of the inventions of our progress are on the market promptly—so promptly and in such detail that it is not an exaggeration to say that should the historian in the future have nothing but a collection of our best toys, he would be able to appraise our age with a fair degree of accuracy. Is our transition from the age of the horse-drawn vehicle to the motor age more picturesquely told than in the passing of the hobby horse, so naturally displaced by the toy automobile?

HE IS A GOOD RUNNER

"Felix" will sprint through the air at a good clip as long the ring is kept in motion

This embodiment of industrial and mechanical advances in the toys of our nation cannot be overlooked from an educational standpoint. Keeping the child abreast of the times and doing it in a manner that does not savor of compulsion is a serious problem that is, in a large measure, answered by toys. Our future engineers, scientists and world leaders are now in the home playing with toys. Will these help to fit him for the coming years? If properly selected, they will do just that and some day, the toy manufacturers will be able to chalk up other triumphs for their craft.

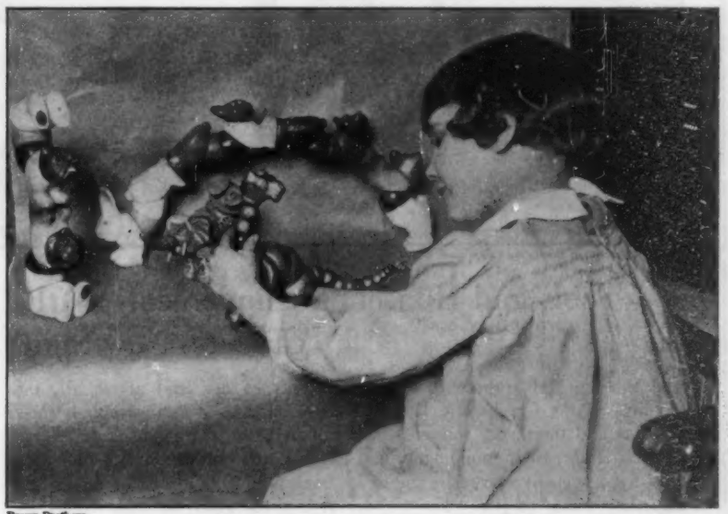
Elephants in Illinois! Not live ones, but something just as interesting—fossil remains that have an important place in history. The discovery will be described in an early issue.



Brown Brothers

LEARNING TO RUN ALL KINDS OF MACHINERY

This young man is surely the envy of all the other boys, because he is the proud owner of a complete miniature machine shop driven by an electric motor. The toys are exact duplicates of large machines in every-day use



Brown Brothers

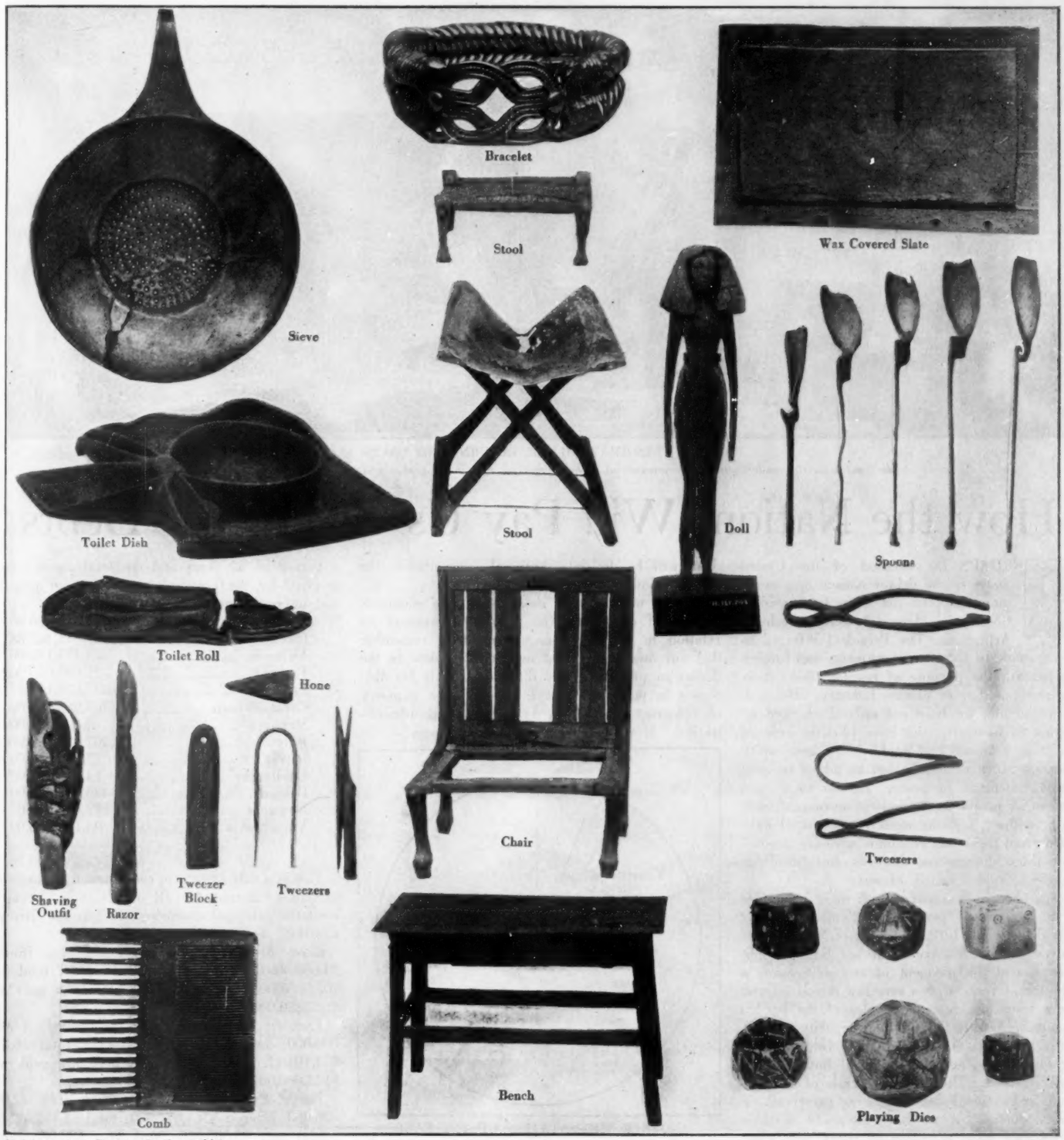
UNBREAKABLE TOYS OF QUEER SHAPES

With segmented figures of the type shown, the child can amuse herself for hours. The animals can be twisted into all sorts of shapes, yet they cannot be damaged. The joints are entirely flexible so that the parts are easily movable

All photos copyright by The Metropolitan Museum of Art

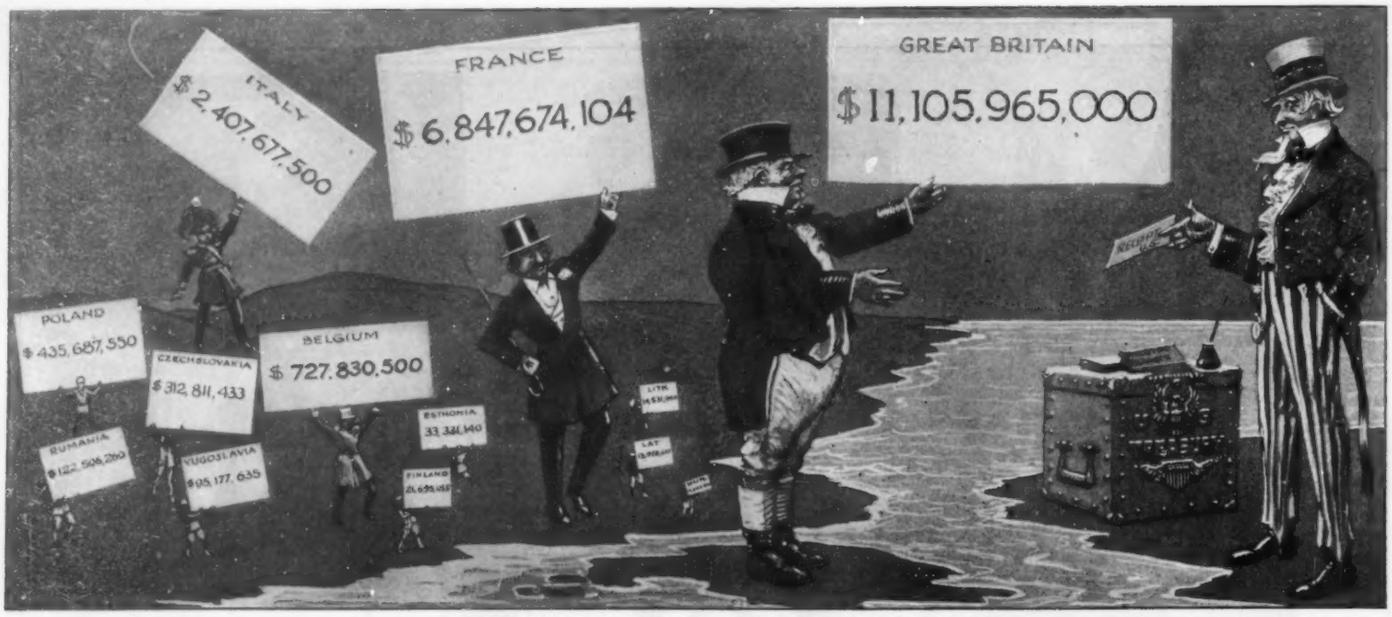
Tools and Household Implements of the Ancient Egyptians, Preserved by the Dry Climate, Now Show Us How They Lived

The monumental records and various works of art, and above all, the writings of the Greeks and Romans, have made us acquainted with their customs and their very thoughts, and although the literature of the Egyptians is slight, their monuments and the remains of the utensils that they used have been preserved by the dry climate and now afford us an insight into their mode of life. The wonderful impetus given to archaeology by the recent discoveries in Egypt is one of the most interesting cultural events of the century. We have already described the glories of Tutankhamen's tomb and we now pass to another interesting phase. How did the Egyptians live and work and enjoy themselves generally? We find that their lives were very much like ours, for their civilization was quite advanced for the remote period. It is difficult to visualize these conditions, but a visit to The Metropolitan Museum of Art in New York will go far toward shaping our ideas about these wonderful people. A number of years ago, Mr. A. M. Lythgoe, Curator of Egyptian Art, conceived the idea of having a series of cases devoted to articles used in the daily life of the



All photos copyright by The Metropolitan Museum of Art

Egyptians. The exhibits have been gleaned from the excavation of ordinary sites which have brought to light a great variety of articles of everyday use. Of these, only some of the general classes need be enumerated—such as, for example, pottery, dishes, vessels, and stone jars; knives and other implements of bronze and flint; bronze needles and loom-weights of limestone and Nile mud; weights of stone and bronze; measuring-rods; articles for the toilet; bronze fishhooks and lead sinkers for weighting the fish-nets; wooden tools, such as the hoe, the rake and the winnowing-scoop; written documents, generally on papyrus, including letters, contracts and even medical recipes; children's rattles, dolls, and toys, particularly in terra cotta, representing various animals; musical instruments such as the harp; and rush-mattings which had been employed as floor-coverings or door-hangings, many of them similar to those in use in modern Egyptian houses. In another part of the exhibit we see scales like the old apothecary used some 75 years ago. Here are mallets identical with those which stone masons and gold beaters are wielding in this very day. Carpenters in ancient Egypt used the square, and bricklayers the chalk line, little improved today. Some of their agricultural implements were excessively crude and their idea of a pulley is very naive. We can imagine little Egyptian children scrambling for camp stools, such as the one shown. Paint, powder and bobbed hair were all very much in evidence, and there were parties where we have incontestable proof that little cubes were made to turn somersaults like our present-day dice. The coarse and fine-toothed comb, illustrated above, also was an Egyptian invention.



THE FORTUNES THAT WILL BE RETURNED TO UNCLE SAM

The figures on the cards indicate the amounts of money, principal and interest, that will pay off the various war debts

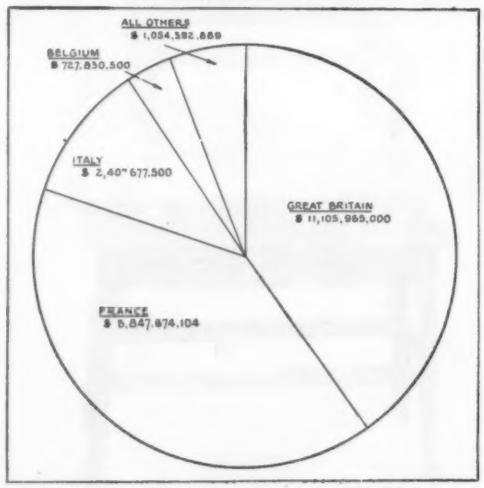
How the Nations Will Pay Us Their War Debts

PERHAPS the relation of the United States to the debtor nations was never more happily put than in President Coolidge's Memorial Day speech at Arlington. The President referred to the loans made to foreign governments and foreign enterprises for the purpose of re-establishing their public credit and their private industry. He said, "By such action, we have not only discharged an obligation to humanity, but have likewise profited in our trade relations and established a community of interests which cannot be but an added security for the maintenance of peace. Insofar as we can confirm other people in the possession of profitable industry, without injuring ourselves, we shall have removed from them that economic pressure productive of those dissensions, discords and hostilities which are a fruitful source of war.

"It has been in accordance with these principles that we have made generous settlements of our foreign debts. The little sentiment of 'live and let live' expresses a great truth. It has been thought wise to extend the payment of our debts over a long period of years, with a very low rate of interest in order to relieve foreign peoples of the burden of economic pressure beyond their capacity to bear. An adjustment has now been made for all these major obligations, and they have all but one been mutually ratified. The moral principle of the payment of international debts has been preserved.

"Every dollar that we have advanced to these countries they have promised to repay with some interest. Our National Treasury is not in the banking business. We did not make these loans as a banking enterprise. We made them to a very large extent as an incident to the prosecution of the war. We have not sought to adjust them on a purely banking basis. We have taken into consideration all the circumstances and the elements that attended the original transaction and all the results that probably will flow from their settlement. They have been liquidated on this broad and moral humanitarian basis. We believe that the adjustments which have been made will be mutually beneficial to the trade relations of the countries involved, and that out of these economic benefits, there will be derived additional guaranties to the stability and peace of the world.

"While we are thus desirous of the economic welfare of other countries in part because of its relation to world peace, we ought to remember that our own government owes a great duty to the American people in this direction. It is for this reason in part that I have insisted upon a policy of constructive economy in the national administration. If we can make the circumstances of the people easy, if we can relieve them of the burden of heavy taxation, we shall have contributed to that contentment and peace of mind which will go far to render them immune from any envious inclination toward other countries. If the people prosper in their business, they will be the less likely to resort to the irritating methods of competition in foreign trade out of which arise mutual misunderstandings and animosities."



ANOTHER PRESENTATION OF THE FACTS

"Pie chart" showing the distribution of debts under the debt settlements made with foreign governments

Now, let us see what the nations have borrowed, with the amounts to be paid including interest. The terms of payment allow the debts to run over a period of 62 years and the total amount to be received by the Treasury, on account of principal and interest is as follows:

Belgium	$727,830,500.00
Czecho-Slovakia	321,811,433.88
Esthonia	33,331,140.00
Finland	21,695,055 90
France	6,847,674,104.17
Great Britain	11,105,965,000.00
Hungary	4,693,240.00
Italy	2,407,677,500.00
Latvia	13,958,635.00
Lithuania	14,531,940.00
Poland	435,687,550.00
Rumania	122,506,260.05
Yugo-Slavia	95,177,635.00
	$22,143,539,993.10

This is a tidy little sum even though we may have to wait a lifetime for all of it. Now, let us see what the principal countries will pay the first year and the "peak" years.

Great Britain: Principal of debt (as funded) $4,600,000,000; interest $6,505,965,000; total $11,105,965,000. Initial year $161,000,000; peak year $187,250,000.

France: Principal of debt (as funded) $4,025,000,000; interest $2,822,675,104.17; total $6,847,674,104.17. Initial year $30,000,000; peak year $125,000,000.

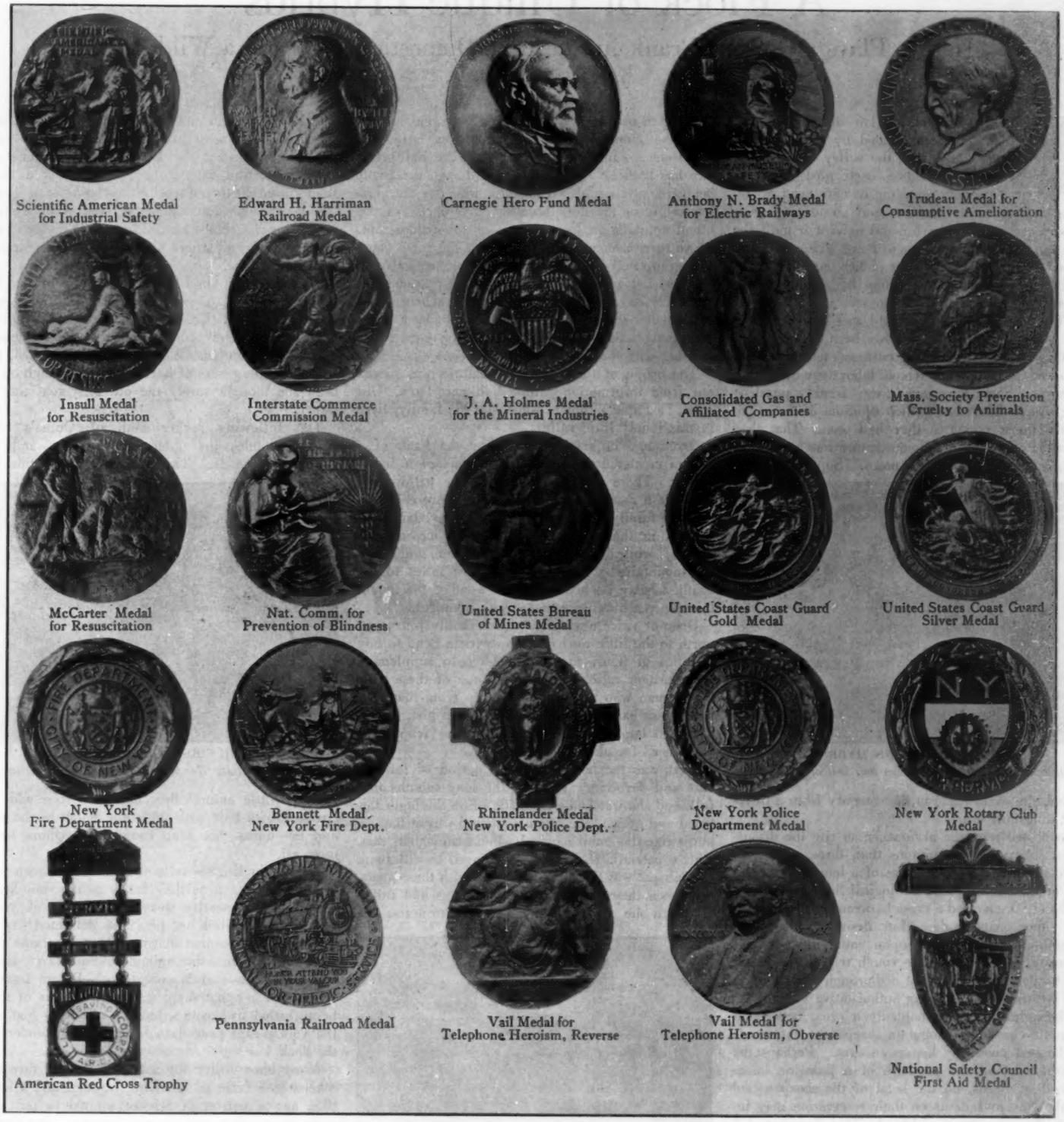
Italy: Principal of debt (as funded) $2,042,000,000; interest $365,677,500; total $2,407,677,500. Initial year $5,000,000; peak year $80,988,000.

Belgium: Principal of debt $417,780,000; interest $310,050,500; total $727,830,500. Initial year $3,840,000; peak year (1984) $12,868,000.

It would be tiresome to consider the other countries as the arrangements are practically the same.

So, if, as the President said, we are not in the banking business we have been at least considerate, and we almost said have "tempered the wind to the shorn lamb."

In the detection of crime, bullets and guns can tell mute yet reliable tales when properly examined. Read about this latest development in an early issue of this publication.


Scientific American Medal for Industrial Safety
Edward H. Harriman Railroad Medal
Carnegie Hero Fund Medal
Anthony N. Brady Medal for Electric Railways
Trudeau Medal for Consumptive Amelioration
Insull Medal for Resuscitation
Interstate Commerce Commission Medal
J. A. Holmes Medal for the Mineral Industries
Consolidated Gas and Affiliated Companies
Mass. Society Prevention Cruelty to Animals
McCarter Medal for Resuscitation
Nat. Comm. for Prevention of Blindness
United States Bureau of Mines Medal
United States Coast Guard Gold Medal
United States Coast Guard Silver Medal
New York Fire Department Medal
Bennett Medal, New York Fire Dept.
Rhinelander Medal New York Police Dept.
New York Police Department Medal
New York Rotary Club Medal
American Red Cross Trophy
Pennsylvania Railroad Medal
Vail Medal for Telephone Heroism, Reverse
Vail Medal for Telephone Heroism, Obverse
National Safety Council First Aid Medal

Peace-time Medals for Heroism and Service

The "Scientific American Medal for Industrial Safety" has been awarded eight times by a Committee of the American Museum of Safety for safety inventions. The "Edward H. Harriman Railroad Medal" is awarded for the promotion of safety on railroads. The "Carnegie Hero Fund Medal" is for notable cases of life saving. The "Anthony N. Brady Medal" is awarded for safety. The "Trudeau Medal" is for the relief of consumptives. The "Insull Medal" is for resuscitation from electrical shocks. The "Interstate Commerce Commission Medal" is awarded to railroad workers. The "Joseph A. Holmes Medal" is for heroes in mineral industries. The Consolidated Gas Company of New York and affiliated companies offer a medal. A medal is bestowed by the Massachusetts Society for the Prevention of Cruelty to Animals. The "McCarter Medal for Resuscitation" is in the gas field. The National Committee for the Prevention of Blindness have a medal for services to the blind. The United State Bureau of Mines awards a medal for bravery. The United States Coast Guard bestows both gold and silver medals. We illustrate several medals for heroes of fire and police departments. The Rotary Club of New York awards a medal for conspicuous services to humanity. The "American Red Cross Trophy" is given for emergency work. The "Pennsylvania Railroad Medal" is for safety work. The late Theodore N. Vail created a fund for awarding bravery medals to telephone operators. The "National Safety Council's First Aid Trophy" is a great incentive.

A Flock of Unique Hybrids

Nature Plays a Curious Prank in Mating a Domestic Sheep and a Wild Ram

By Ethel W. Musgrave

IN an isolated section of southwestern Arizona, surrounded by barren desert mountains, lies the valley of Quijotoa. Tall, forbidding cacti gird it about, jealously guarding its entrance. So remote is it from civilization and so uninviting in appearance that few have cared to visit it until the last two or three years, when it was discovered that here Nature had played one of her curious pranks and had created a small group of animals worth traveling many rough miles to see.

The old adage that the world will beat a path to the door of the truly great has been demonstrated in this instance, for many curious sightseers have followed the trail to this remote laboratory of Mother Nature's. Some have come away frankly puzzled; others have differed as to their opinions of the origin of the queer creatures they had seen. That they were the offspring of a domestic ewe was an assured fact, but the sire was unknown. Supposition has

THE QUEER BROWN HYBRID

Its body is covered with brown hair instead of wool

placed him everywhere in the category from a billy-goat to a mule deer.

So heated were the arguments, so rife the discussions, so varied the opinions that, three years ago, the news drifted into the office of a local representative of the United States Biological Survey. He immediately discredited a cross between domestic sheep and either goats or deer; but, desirous of securing scientific data, and bent upon satisfying personal curiosity, he undertook the rough trip to the Mexican border where he made a thorough investigation and returned the following authoritative verdict:

The animals are undoubtedly a cross between a domestic ewe and a mountain sheep—the only cross of the sort positively known to exist. Perhaps the coarse hair and the presence of a pair, or sometimes four horns, on the head of the sheep raised by the Navajo Indians on their reservation may indicate the same strain of blood. That, however, can be only conjecture.

The little group in Arizona was found to consist of one old unshorn ewe, the mother and grandmother of the line, a half-breed ewe with a lamb, a magnificent ram, and, queerest of all, a dark brown creature with no vestige of wool but covered with coarse hair and equipped with a pair of dark, heavy, corrugated horns. All have well-built bodies, sturdy, square feet, bright, beautiful eyes and a light rump spot, unmistakable marks of mountain sheep. The old ewe has undoubtedly mated with a mountain ram, for the entire line shows the same cross-breeding, a result both amazing and amusing.

The first, and therefore the eldest of the hybrids is the half-breed ewe. Following a second mating with the mountain sheep a male was born, the handsome young ram referred to. The half-breed ewe has likewise mated with a wild ram, the result being the strange brown creature which is the most interesting of the flock because three-fourths of the blood coursing in her veins is of the wild strain. These three are certainly hybrids of the rarest sort. The group had increased, by last year, to twelve in number, but what the younger lambs are, none can positively say. They are, of course, hybrids, too, but whether they were sired by a wild sheep or by the young half-breed ram that is now grown and running with the flock none may know.

The origin of these strange creatures was pieced out from information gathered in part from "Old Juan," a Papago Indian, who, with his family, lives in this lonely little valley.

Years ago he selected a site on the bank of a stream created by the bubbling waters of a living spring. There in the shade of a huge willow tree he built a small house of adobe and proceeded to rear a family. The mother and the daughters worked in the garden, raising beans, melons and "chilis," while Juan roamed abroad, often going into the mountains of old Mexico, a few miles to the south, whence he brought home meat of the mountain sheep which were there quite plentiful.

Once or twice a year the entire family journeyed north to the little towns of Ajo or Gila Bend to buy supplies of flour, sugar and coffee to supplement their meager rations. It was on one of these trips that a man who was shipping sheep from that railroad point had given to the little Indian girl, Quina, a small lamb, an unfortunate little "leppy" or "bummer" forsaken by its mother.

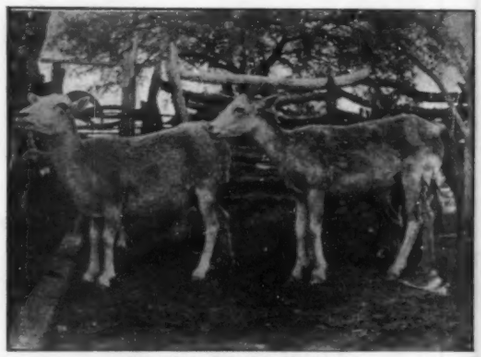
That was the beginning of a period of faithful care and devotion. Through the long months that followed she watched with pride while the lamb fattened and grew. She often wondered why it had no horns like the small band of white nanny-goats that, with a patriarchal old billy, belonged to old Juan. Quina's pet was turned out to graze with these goats, and when they went into the mountains and failed to return she trudged many weary miles across the desert to find them and drive them home. But that winter the girl went to a government school, and during her absence the animals roamed about as they chose, and were gone for weeks at a time. Juan knew that their favorite resort was on a mountain between his hut and Altas Tinajas (The High Tanks) or waterholes where the mountain sheep were so numerous, and where, it is probable, the strange mating occurred.

THE HALF-BREED RAM

He was three years old when this picture was taken

Winter passed, and one day in late spring the lamb, now a full-grown ewe, came in with a wee lamb at her side. Quina was delighted, and, gathering the baby ewe into her arms, looked lovingly into its bright eyes. When, shortly afterward, she discovered the points of horns coming through on its head she thought surely the old billy-goat was its father.

The following spring both of Quina's ewes brought lambs, the older one a male, and the younger a female. The Indians thought this the



THE FIRST-BORN HYBRID

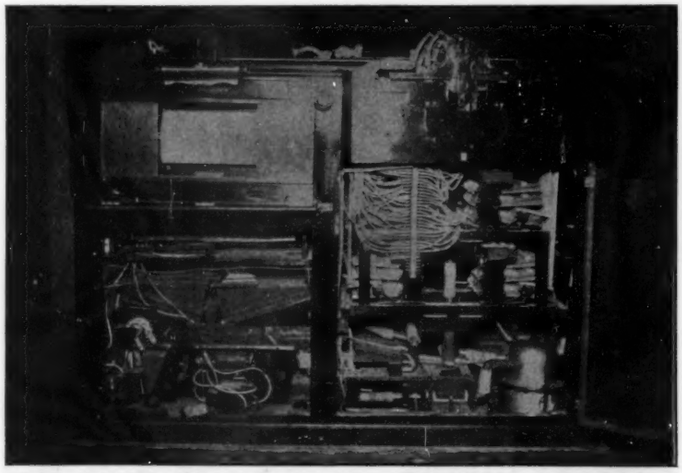
She is on the left. Her second offspring is on the right

funniest little animal they had ever seen with its coarse brown hair with the white patch in the rear and the horns that soon came. But Quina loved them all.

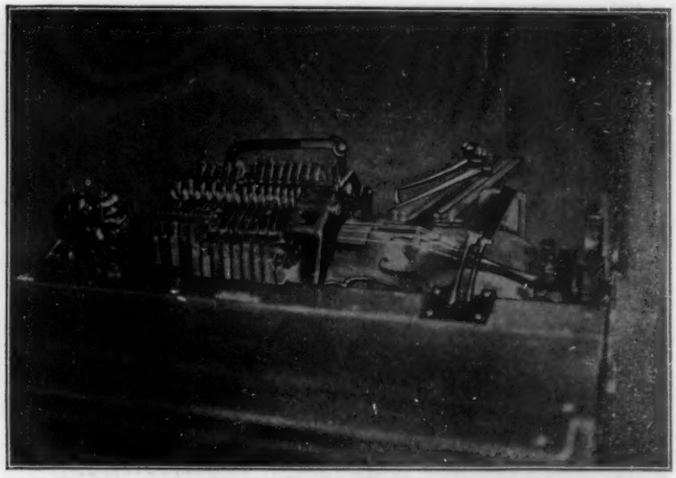
In fair English she tells of how a white man rode up to watch them as they drank in the cool brook while she sat nearby weaving a basket of yucca fibre. He admired her pets and delighted her by expressing the opinion that they must surely be part mule deer, because that animal has such heavy horns and also wears a light rump spot. Before leaving, he warned her that there was great danger of their being killed by coyotes, but the old billy-goat and the young ram proved to be capable defenders of the flock.

Many have visited the valley to see the rare animals whose fame is spreading rapidly, and a short time ago a patron of science wanted to purchase them as a gift to the state university. But Quina shook her head. "No want sell," she said. "Maybe take hund'ed dollar, one sheep." The sale was not made.

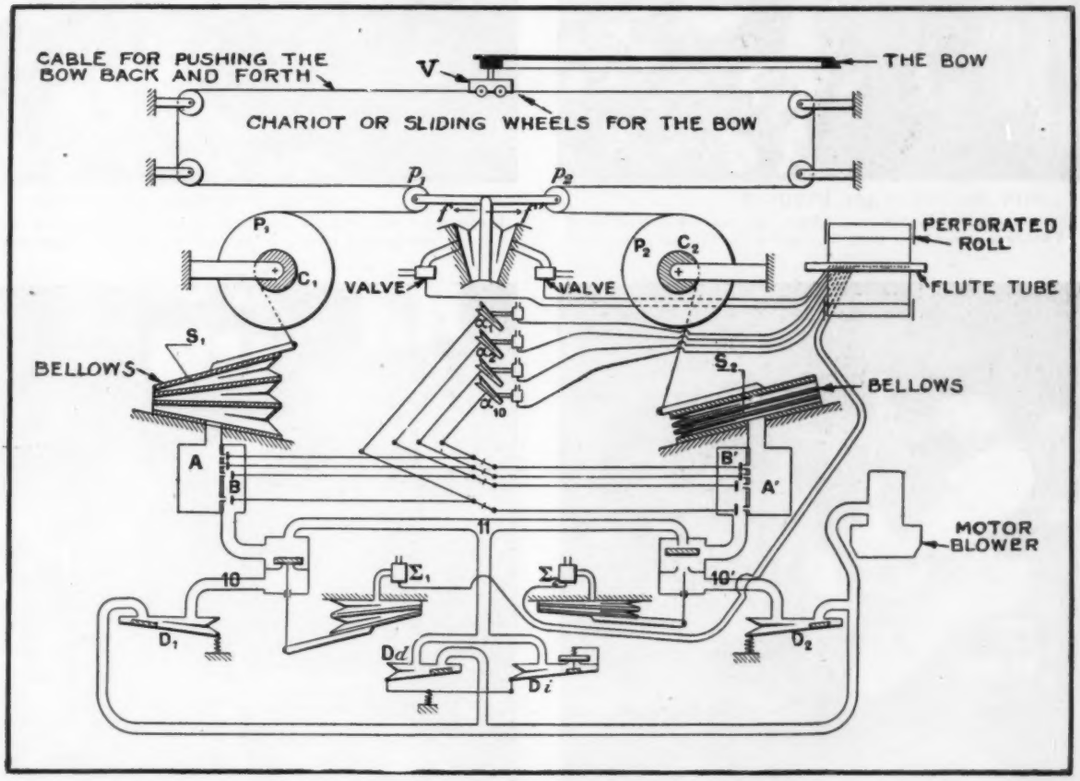
It seems inevitable, however, that some day they will be bought by someone who will perhaps place them in a private park where they will be under constant observation and where an accurate record will be kept of their increase. Even as this article is being written rumors are afloat that negotiations are under way for such a deal. Let us hope that these efforts are successful, for although a park may not furnish so picturesque nor so unusual a setting as was the valley of Quijotoa, it may mean the assured preservation of this group of rare hybrids.



A view of the "Violonista" with cabinet open to show interior mechanism



Top of the instrument, showing the position of the violin and the bow



How the "Violonista" is operated. The small chariot, V, to which the bow is attached, moves back and forth over the violin strings, being actuated by the cables passing over pulleys P_1 and P_2. These are attached to the bellows, S_1 and S_2, through wheels C_1 and C_2. The air necessary for operation is fed to the bellows through the regulators D_1 and D_2. Besides the latter and the electric blower, there are other auxiliary bellows and valves Dd, Di, E_1 and E_2. These regulate the pressure in the air reservoirs A. B., A_1 and B_1. The smaller bellows, a_1, a_2 and a_{10} control the action of the perforated music roll which in turn controls the operation of the artificial fingers and the bow

A Violin Played by Mechanical Hands

One of the intriguing problems that has held the attention of mechanical engineers for at least the last three centuries is the production of a device that will play a violin without the aid of human hands. The photographs and diagram above illustrate the latest and most successful attempt but because of the intricacy of the proposition, it is interesting to review the work that has been done heretofore. In 1627 in his "Traité de l'hormonie Universelle," Father Marsenne mentions a device of German origin which was called the "Harpsichord" and which was purported to produce mechanically the sounds of a violin. The apparatus, however, was very crude and the best record that we have of an instrument of this kind that was really successful is that of the "Virtuosa" which was perfected in America in 1908. In this device, the fingering of the strings was accomplished by means of keys that were actuated by electro magnets. The strings were set in vibration by one or more whirling disks that were brought in contact with them as required for the rendering of a musical piece. This instrument was quite a success musically but from a mechanical standpoint, it had several weak points. Not the least of these was its short life. Now we have the "Violonista," perfected by two Frenchmen, Emile d'Aubry and Gabriel Bareau. The musical score for the Violonista is perforated on a roll of paper in much the same manner as that for a player-piano. The perforations control the flow of air and consequently the actions of the mechanical fingers and the bow. The positions of the parts are shown in the photographs. The violin proper is mounted on a series of hinges. The mechanical fingering and the bowing is said to be nearly perfect.

HOW THE PELTS ARE REMOVED

Many of the furs that are received by the establishment are not yet removed from the bodies. Therefore, a workman must be detailed for this purpose

WHERE THE SKINS ARE SORTED

At this point, the pelts are separated into two general classes consisting of the large and perfect ones and the smaller ones with slight imperfections

REMOVING THE SURPLUS FLESH

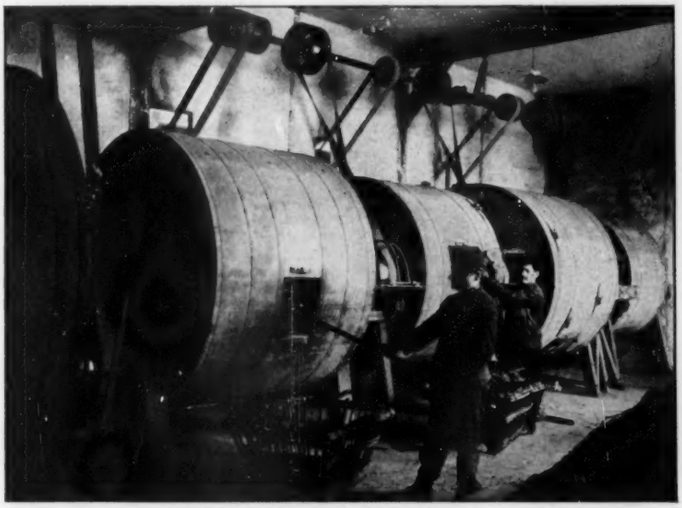
In order to prevent the spoiling of the skins by the decay of small bits of flesh and fat that might cling to them, this knife is used for scraping

SOAKING WITH A SALT SOLUTION

Skins are made soft and pliable by the liberal application of a solution of salt and water. The density of the saline solution is gradually reduced

How 50,000,000 Rabbits Furnish Milady's Furs

With the enormously increased demand for fur wearing apparel has come a corresponding decrease in the supply of natural furs of all kinds. Hunters and trappers have been unable to keep up with the demand for different kinds of animal skins and as a result, a new industry has sprung up. This has to do with the conversion of rabbit skins into fur garments and so manipulating the pelts during the curing process that the finished coat, neck piece or other article of wearing apparel will resemble one or the other of the various expensive furs that are now hard to obtain. The photographs on this and the opposite page show the more important steps in the process. The rabbit skins are first collected from various sources. Amateur and professional rabbit breeders contribute from their stocks. When the pelts arrive at the fur-converting establishment, they are sorted into two general groups, one containing the large and perfect pelts and the other the small and imperfect ones. These two grades go through different processes as will be described below. We will first deal with the large, perfect skins. A special knife is employed for the purpose of removing the last vestige of flesh from the back of the skin in order to give the pelt a perfectly smooth surface. The skins are then treated in a salt-water bath to make them soft and pliable and to enable the workers to handle them easily. The strength of the solution is gradually reduced and after the pelts are stretched to their original sizes, they are washed thoroughly in water. Soap and a brush are vigorously applied in this step. The skins are now transferred to a so-called "fulling mill" where they are given a thorough rubbing and stretching. A sour-bran bath now awaits and the skins are put in it. This is for the purpose of causing the pores to expand. After a few days, the pelts are removed, covered with alum and placed in revolving casks, which are kept turning until the furs are completely dry. In the



HERE THE SKINS ARE DRIED

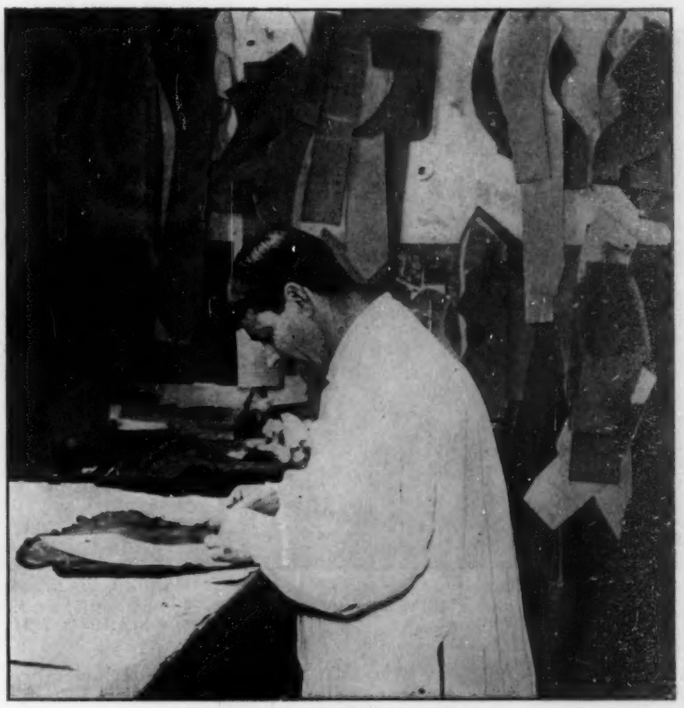
After a layer of alum is applied to the wet pelts, they are collectively placed in these revolving casks and "tumbled" until they are thoroughly dried

HOW OIL IS APPLIED TO PELTS

The second or inferior grade of skins are subjected to an oiling or greasing process during which olive oil or pork grease is rubbed thoroughly into them

ONE OF THE IMITATION PROCESSES

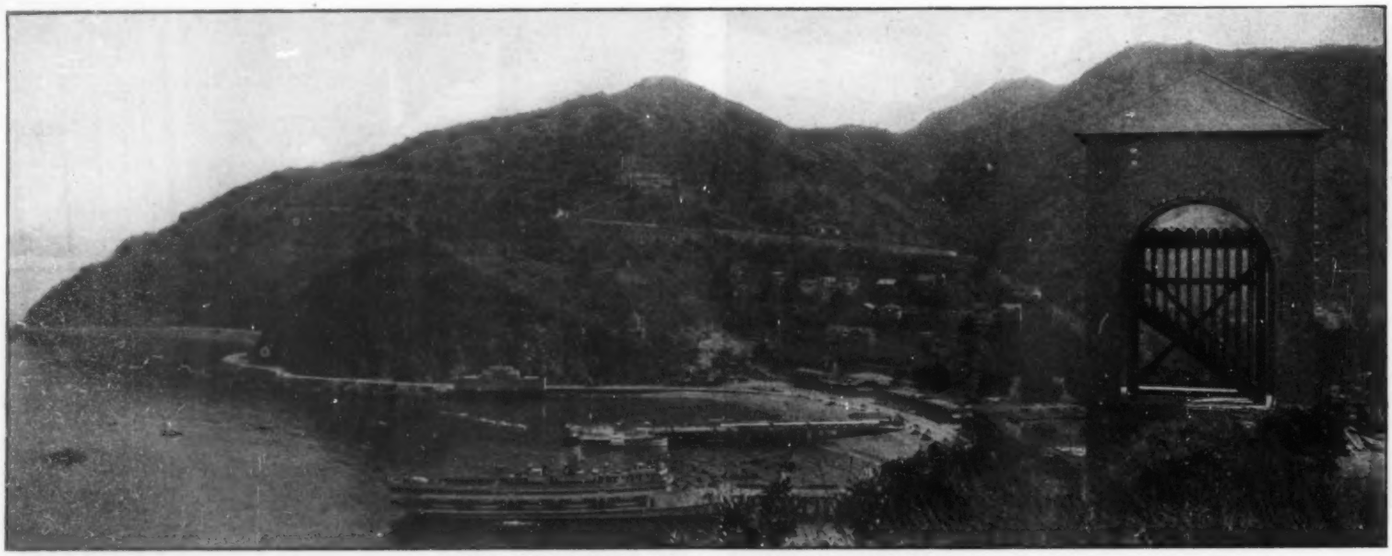
This ingenious machine stretches the rabbit furs so that they lose their original shape and assume that of an otter skin. The value is thus increased



ONE OF THE FINAL STEPS

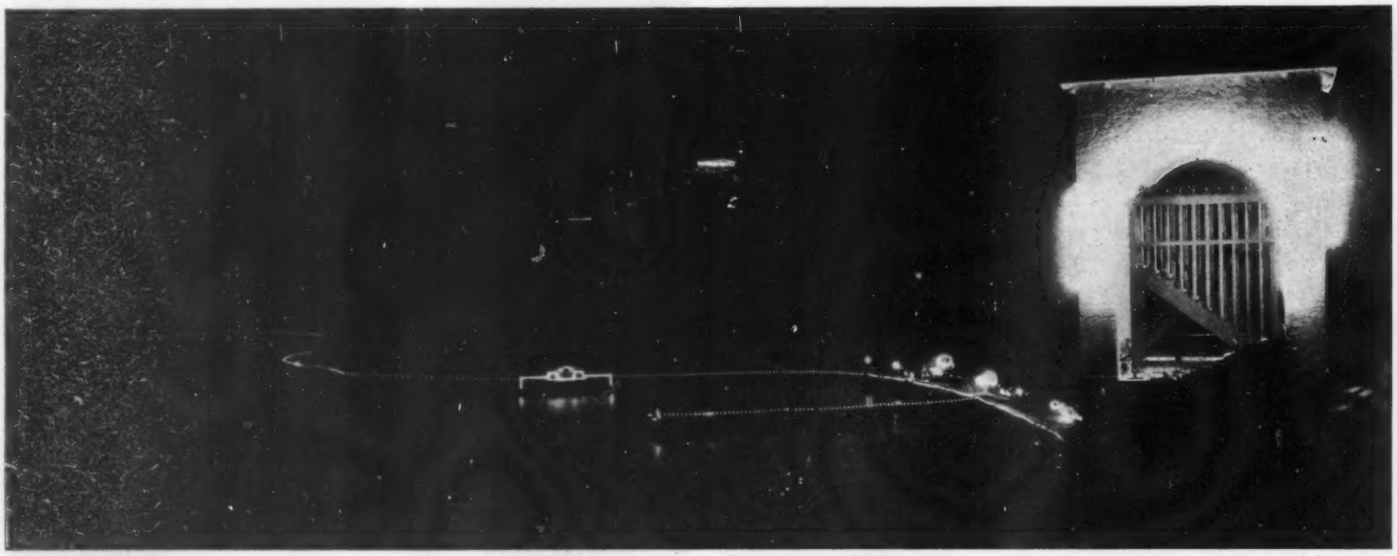
Cutting the cured and treated skins. Note the various forms and patterns from which the pelts are cut to the required shape for different garments

curing treatment for the lower grades of furs, the process, except for the "fleshing" or removal of the bits of fat and flesh that cling to the pelt, differs materially. After this has been done, the skins are sewed together in pairs and are then covered with either pork grease or olive oil. The fulling process is employed to completely saturate the skin with the oil or grease. In order to allow plenty of time for the absorption of the material, the pelts are allowed to stand for a few days. They are then stretched out to dry in the open air and in order to insure proper softening, they are subjected to a light beating with a rod. It is, of course, necessary that none of the grease or oil remain on the surface of the skin as the only place where these are wanted is in the pores. Therefore, the pelts are placed in the drying casks until the outer surfaces are completely free from oil or grease. Another softening beating follows and then steel combs are used to straighten the hair and smooth it out. This completes the curing process for both the high and the low grade pelts and from this point on, the treatments are practically identical. The next step is to impart a luster to the hair and to hide any defect in the pelt that might lower its value if detected. Machines are used in this "lustering" process. These systematically rub and brush the furs, working them into the best possible condition. During this part of the treatment, a solution of alcohol, gum-lac, glycerine, yolk of egg and cottonseed oil is worked into the pelts. The furs are then ironed out. They are now colored according to the name under which they will eventually be sold. For instance, to imitate leopard skin, a solution of hyposulphite of soda is applied. Of course, the texture of the skin, the length of the hair and the appearance of it enter into the determination of the type of skin for which the rabbit furs will be sold. After they are sorted according to these classifications, they are passed along to the camoufleur. Here, as mentioned above, they may be spotted to imitate leopard skin, or they may be subjected to other treatments that will produce simulations of the hides of other animals. For one of these, the operator shaves off the upper part of the hair with a specially designed machine. Following this, the hair is touched up at the roots with a solution of alcohol and potash of soda. Any loose fur is then removed by beating.



THE MOST COMPLETE SET OF CHIMES IN THE WORLD

Situated on a hill, overlooking Avalon Bay are these chimes. Daily their beautiful tones are flung out on the air, to be heard five miles out to sea. They are made to strike the hours, half and quarter hours as well as to furnish musical entertainment



STANDING AS A BEACON FOR SHIPS AT SEA

The nocturnal illumination of the chimes is said to be of value to navigators of small boats who do not make landings before dark. The striking effect of the chimes and the lighted water-front of Avalon Bay is vividly shown in the above photograph

The Chimes of Catalina Island

Located 230 feet above Avalon Bay, on Catalina Island, and housed in a beautiful tower, a set of chimes issue forth a welcome to each incoming passenger steamer with its freight of vacationists. On the departure of the vessels, the melodious tones send their farewell notes out over the sea, chiming *au revoir*. The chimes are played in accompaniment to the nightly concerts of the Catalina Marine Band in the Greek Amphitheater, located a mile distant across the lovely cove where the picturesque city of Avalon is situated. With the striking of each hour, half and quarter hour, the chimes peal forth their musical chords. At vespers they are used for a special musical service, while on festive occasions a program of selected numbers is played from the console located in the offices of the Santa Catalina Island Company. Not only does the beautiful sound penetrate five miles out to sea, but via radio the chimes are flashed into the ether through radio station KFWO. Here was one of the most difficult problems which confronted the installers—that of successfully harnessing the tones so that they could be effectively transmitted out into space—but it was solved. Mr. J. C. Deagan, master inventor of percussion musical instruments, states that these chimes are the most complete set in the world. There are twenty tones, D to A, chromatic. A three-horsepower motor and 45-volt generator are located in the chimes tower to operate the bells. It took more than three years to construct the specially designed clock and electrical devices which operate the tubular bells—and it took ten years to make the great tubes themselves! The automatic clock operates the chimes every fifteen minutes during the day, and in addition there are two complete sets of keyboards, or consoles, from which the musical tones can be controlled. Nearly ten miles of wire were required to connect the chimes with the consoles—one located in the offices and the other in the Greek Amphitheater. When the bells were ordered, it was distinctly specified that their tonal qualities be soft, musical and free from any harsh metallic qualities. To achieve this meant special testing—month after month of painstaking experimenting during which time 94 alloys and more than 100 different wall and diameter proportions were considered before the ideal of perfection was secured. Then came the problem of atmospheric conditions at the island. The long steel tubes were to be subjected to sudden changes of temperature from the sea air and from the heat. This situation involved considerable testing, and difficulty was encountered owing to the expansion and contraction of the metal, which affected the tonal quality. Unlike cast bells, these chimes make possible extreme accuracy of tuning, even intonation, and uniform volume, carrying capacity and tonal characteristics throughout the entire register, no matter at what distance the sounds are heard.

How Washington's Garbage Pays Dividends

Efficient Disposal Plant Reclaims Valuable Oils and Greases

By Nell Ray Clarke

THE lowly garbage pails of the District of Columbia have been furnishing one of the principal ingredients of a brand of toilet and bath soap widely advertised for its purity. At the same time they are yielding a revenue to the United States Treasury of between 50,000 and 75,000 dollars annually. Three-fourths of this sum goes back into the District appropriation, in accordance with the plan for financing affairs, but the other fourth helps to pay the salaries of the President, the postman and the prohibition agent.

The plant which reduces the garbage to oil or grease is an old one, but it yields a better quality of reclaimed material than any other plant in the country. Soap and candle manufacturers offer a premium on its product. The set-up is known as a modified Chamberlain system for the reduction of garbage. The collected garbage is cooked for eight hours and then is put under hydraulic presses and all the grease squeezed out of it. The principal constituents of that grease—stearic acid or stearin, and a little glycerine and red oil—are used in the making of soap and candles. In spite of the fact that the idea is a little revolting, the product is perfectly pure after having been cooked in live steam for such a period of time.

When the garbage men have collected the contents of the family swill buckets in their covered trucks, they dump it into the seventeen 55- to 60-ton gondola cars, each of which carries about 1,950 cubic feet of garbage. The cars steal out of Washington at night, down to the reduction plant at Cherry Hill, Virginia, 30 miles south of the city. There they are shunted off on a siding that runs beneath a platform of the mill.

Over 50,000 Dollars Profit

A grab-bucket hoist mounted on the platform lifts the green garbage, as it is called, up to a receiving tank on the second-floor level of the building. On the first floor of the building there are 24 digesters, which look like tall boilers on end. They measure six feet in diameter on the inside and are 14 feet high, extending up above the second-floor level.

On its way from the receiving room, the garbage is superficially searched for tin cans, bottle tops, pieces of crockery, glass and other substances which might do material damage to the machinery of the plant in some of the later processes. It is then shoveled into the big boilers by way of an opening near the top. The door is then clamped shut and live steam under about 75 pounds pressure is turned on the garbage. This enters the bottom of the tank and percolates thoroughly through the material for eight hours.

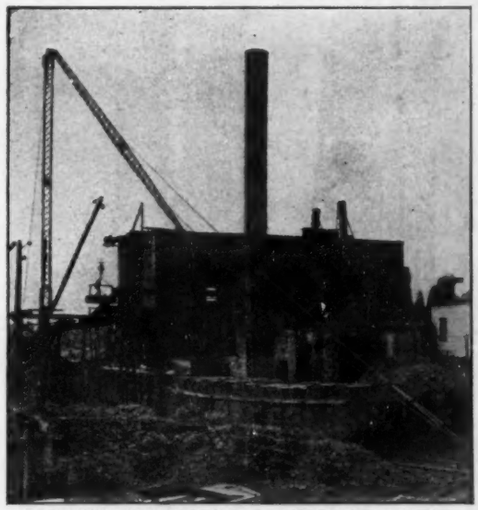
At the end of that time the steam valve at the bottom is turned off and as much water and grease drained off as possible. Then steam is turned on from the top of the tank, the down pressure of which drives out all the liquid in the cooked garbage and leaves only the solid mass, which looks like spinach. The doors to the digesters on the first floor are opened and the garbage is pulled out into a conveyer, consisting of a wooden trough through which a chain moves. The conveyer chain, equipped with scoops, runs beneath the digester and drags the cooked garbage out toward the presses.

A little flat truck, on top of which rests a rack made of thin, green wood like the laths used for plastering, is run up under the conveyer, a board is slipped out of the bottom of the trough, and the conveyer chain scrapes the garbage onto the rack, which has been covered with a sheet of press cloth about five feet square.

The press cloth, incidentally, is one of the most expensive items in the cost of running the plant. It is made of cord about one-sixteenth of an inch in diameter woven into meshes about one-tenth of an inch apart, and permits the grease and water to pass readily through its meshes. It is easily torn in the huge presses by the tin cans, bottle tops, glass and broken crockery which the thoughtless housewife dumps into her garbage pail.

The four corners of the press cloth are then wrapped over the garbage and another rack is placed on top, another press cloth placed on top of that and more garbage dumped on until the pile becomes about six feet high. The car is then pushed on rails beneath a ram, and gradually the great arm of the press pushes the little truck with its odoriferous burden upward against the flat top of the press.

The plant is now using 12 hydraulic presses under 4,000 pounds pressure per square inch, or 300 tons



WASHINGTON'S GARBAGE REDUCTION PLANT

Two gondolas are shown, loaded with garbage which is being dumped from the bins to the second floor of the building

pressure per press. They are built to produce 6,000 pounds to the square inch, the difference representing the margin of safety. In order to get this high hydraulic pressure, a duplex steam pump with 16-inch diameter steam pistons and 1¾-inch water pistons is used.

The grease and water trickle out into a trough beneath the press. This trough leads to a series of concrete tanks arranged in tiers. As the mixture cools, the water settles to the bottom and is drawn off from beneath, and the grease is dipped out by means of a perforated pipe which must be held on the surface of the liquid.

At one time the residue from the process, or the press cake, as it is called, was thoroughly dried in a separate drying plant and sold for fertilizer, but the process employed necessarily increased the fire risk to a grease-saturated plant. At that time, fires constantly broke out at the plant and did a great deal of damage. In addition, the fertilizer had to be stored until a suitable market could be obtained for it.

When the bottom dropped out of the fertilizer market, several years ago, the drying was discontinued, and the press cake is now used for fuel for the furnaces of the plant itself, with the result that the operators have saved 40 percent of their coal bill, which incidentally amounted to more than they could have received for the fertilizer at the present reduced prices.

During the last fiscal year, 72,927 tons of garbage were collected in the District of Columbia. Of that amount 69,392 tons were reduced, some of the collection having been sent to Blue Plains, the Home for the Aged and Infirm of the District, to be used for pig feed, and some of it being thrown away for various reasons. The 69,392 tons produced 3,629,875 pounds of grease, which sold for $250,049.44. The cost of production was $191,923.67, which included transportation of the raw garbage, the running of the plant, labor, replacement of worn-out machinery and other repairs.

This saving of more than 50,000 dollars was effected in spite of the fact that the plant is now more than 25 years old. In peak years, the saving has exceeded 70,000 dollars. In all justice, it should be said, however, that the cost of collecting the garbage is not included in the cost of running the plant. If it were added, the sale of grease would just about cover that item also, without showing any margin of profit. The District officials realize, however, that the collection of refuse is a sanitary measure and must be attended to, no matter how the garbage is disposed of.

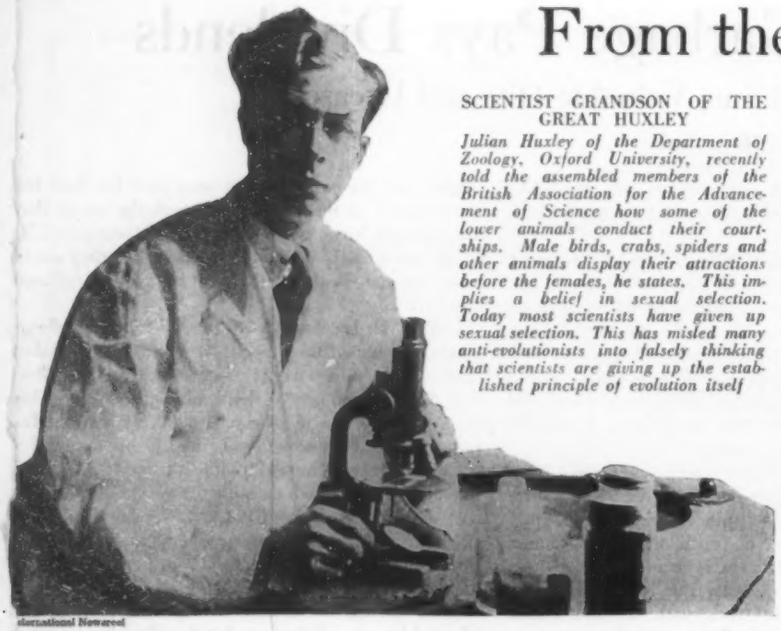
Why a Profit Is Realized

The depreciation in a plant for this kind of work is necessarily very great, as the ammonia in the garbage eats away the piping, but since the District's plant is such an old and inexpensive one, the total is not as great as it would be in a modern plant where the original outlay for machinery was great. The huge digesters of the plant formerly wore out completely in three years. Within recent years, they have been lined with a glazed tile which has increased their life more than four times that long—in fact, about 14 years. For further economy, brass pipes in the boilers are to be tried.

District officials are somewhat puzzled as to why its garbage reduction plant makes money when so many of the more up-to-date plants run into debt. In the final analysis, they believe that the success of their method must be due in part to the able management of Mr. J. G. Crane, an engineer of extraordinary ability who designs much of the required machinery, and in part to the fact that more garbage is collected per capita in the District of Columbia than in any other large city in the United States. Washington has almost no foreign population. As a rule it has been found that immigrants are very frugal; they use every available part of fresh vegetables and meats, while our colored brethren in Washington are as wasteful, or even more so, than the wealthiest white families. For instance, one garbage collection wagon in the white district of Washington will cover as much territory as three wagons can cover in the colored district.

Naturally, the plant is no place for a pleasure tour. One makes no mistake about knowing when he has arrived at the plant or even in its vicinity. Every part of the plant and even the earth around about is reeking in grease, but there is certainly romance in making 70,000 dollars a year out of something which the housewife insists shall be taken out of her backyard.

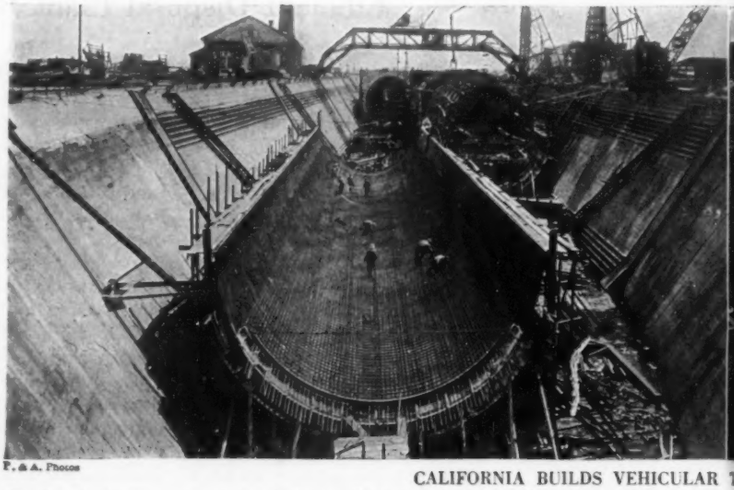
From the Scrap-book of Science—Cam



ternational Newsreel

SCIENTIST GRANDSON OF THE GREAT HUXLEY

Julian Huxley of the Department of Zoology, Oxford University, recently told the assembled members of the British Association for the Advancement of Science how some of the lower animals conduct their courtships. Male birds, crabs, spiders and other animals display their attractions before the females, he states. This implies a belief in sexual selection. Today most scientists have given up sexual selection. This has misled many anti-evolutionists into falsely thinking that scientists are giving up the established principle of evolution itself



P. & A. Photos

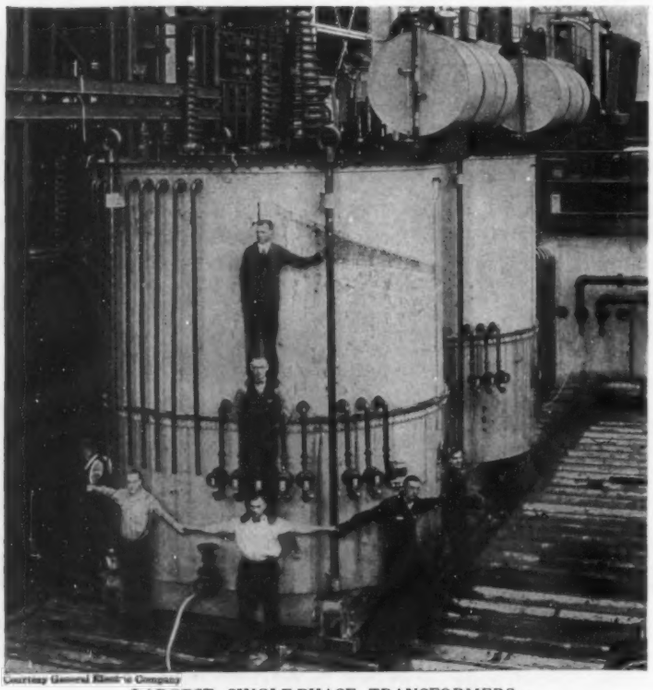
CALIFORNIA BUILDS VEHICULAR TUBE UN

Twelve reinforced concrete tubes having a thirty-two foot bore and weighing a total of 4,500 tons are nect Oakland with Alameda, under the Alameda Estuary. The tubes are being made in drydock, floate

Wide World

PORTABLE FOLDING CLOCK

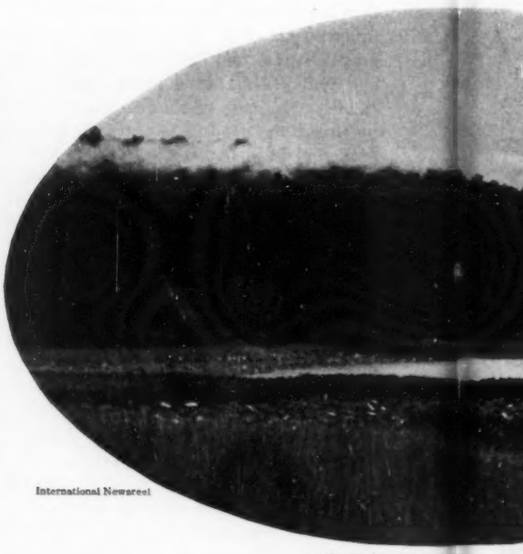
This clock, whose hands are driven by an ordinary "dollar" watch, may be folded up and tucked away in the box carried in the inventor's hand. Its diameter is two feet



Courtesy General Electric Company

LARGEST SINGLE-PHASE TRANSFORMERS

The over-all dimensions of each of these gigantic units are: height, 23 feet 11¼ inches; length 15 feet 7 11/16 inches; width 12 feet 5 7/8 inches. The total weight of each is 202,200 pounds—more than one hundred tons—of which the oil weighs 79,000 pounds. Each unit has a capacity of 28,866 kilovolt-amperes —nearly 40,000 horsepower—at 60 cycles



International Newsreel

AIRPLANE CONQUERS MA

The United States Department of Agriculture the distribution of Paris green from airplan quito larvae. In the final tests more than 9 stroyed when the poison was dusted ove ing areas. A government color on the

Wide World

TYPEWRITER THAT WRITES IN CHINESE

Tze Quon, of Shanghai, has produced a typewriter that writes large numbers of the Chinese ideographs. First a single key arm drops down and picks out the desired character. When used it is automatically dropped back into its original slot. The machine writes 5,700 different Chinese characters and weighs 76 pounds

P. & A. Photos

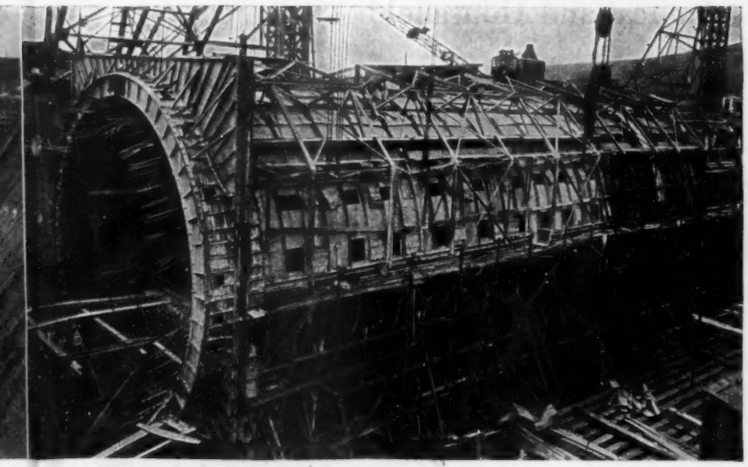
A COOLED POT OF OPTICAL GLASS

At the United States Bureau of Standards, Washington, D. C., optical glass of excellent quality is made for scientific purposes. When the World War came America discovered its dependence on Germany for this necessary material. Germany knew how to make it; we did not. But after some little research a way was found

P. & A. Photos

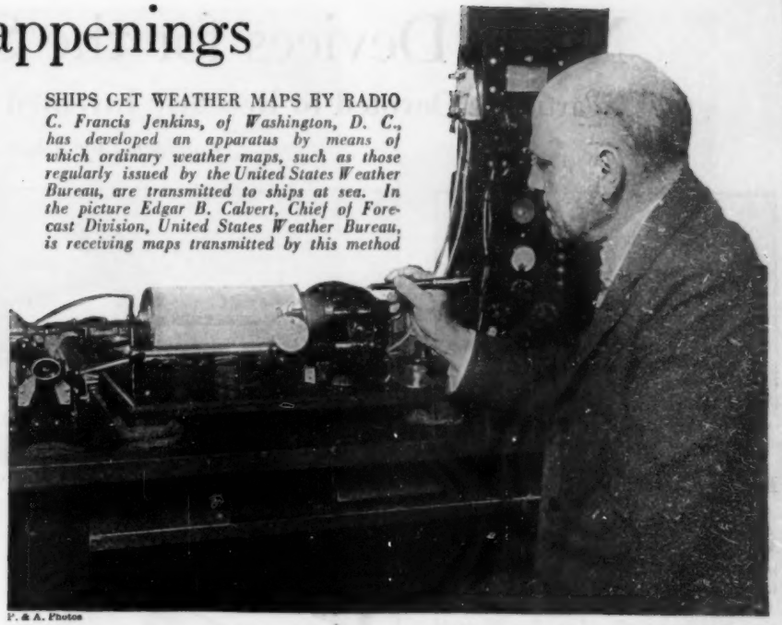
When next
in a wind,
posures are

Camera Shots of Scientific Happenings



AR TUBE UNDER ALAMEDA ESTUARY

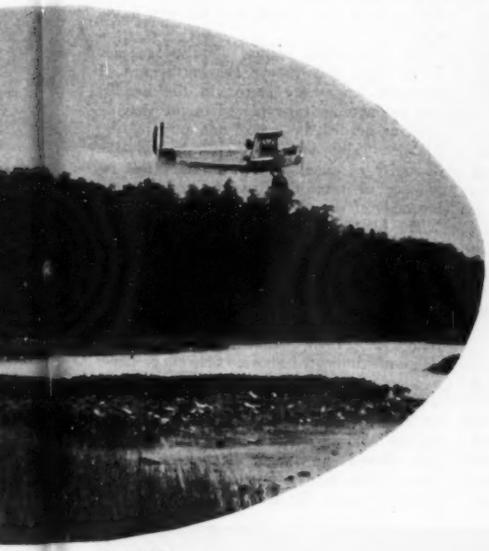
4,500 tons are being built at Hunter's Point, California, for the vehicular tube which will con- drydock, floated nine miles and placed. The total cost of the job will be nearly 4,000,000 dollars



SHIPS GET WEATHER MAPS BY RADIO

C. Francis Jenkins, of Washington, D. C., has developed an apparatus by means of which ordinary weather maps, such as those regularly issued by the United States Weather Bureau, are transmitted to ships at sea. In the picture Edgar B. Calvert, Chief of Forecast Division, United States Weather Bureau, is receiving maps transmitted by this method

P. & A. Photos



CONQUERS MALARIA

ent of Agriculture has been making experiments with green from airplanes, as a control for malaria mos- l tests are than 99 percent of the larvae were de- on was dusted over swamps and mosquito breed- nent cular on the new method has been issued

Wide World

LANDING THE END OF AN OCEAN CABLE

A new cable across the Atlantic from New York, has been added to those already in use. The new one will, however, do the work of several of the old, since it is enveloped with a continuous spiral wrapping of permalloy, an alloy consisting of 78 percent nickel and 22 percent iron. This alloy adds to the permeability of the cable to magnetic flux. This in turn permits signals to be flashed along the cable at much closer time intervals than previously

Kadel & Herbert

PLASTIC MOVIE FILMS

Two German inventors claim to have produced a seemingly stereoscopic film

P. & A. Photos

FILMING THE GROWTH OF PLANTS

When next you see a moving picture of a plant growing, with its leaves waving about as if in a wind, think of this picture. The camera is geared down in such a way that single exposures are taken at given, equal intervals. When these are run through rapidly the slow growth becomes perceptible, plainly showing the various stages

P. & A. Photos

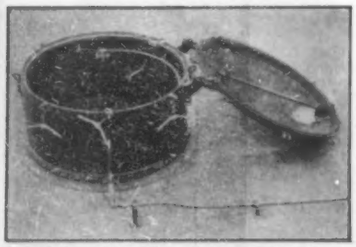
UNCLE SAM TESTS BEFORE BUYING

Before purchasing glassware to equip government owned ships, samples of the various kinds of glass were sent to the United States Bureau of Standards for careful test. Those who visit Washington should not miss the Bureau, where innumerable tests and experiments are continually going on. The Bureau is supported by the Government

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins



Carbon dioxide nozzles in hatch

Liquid Carbon Dioxide to Fight Fires

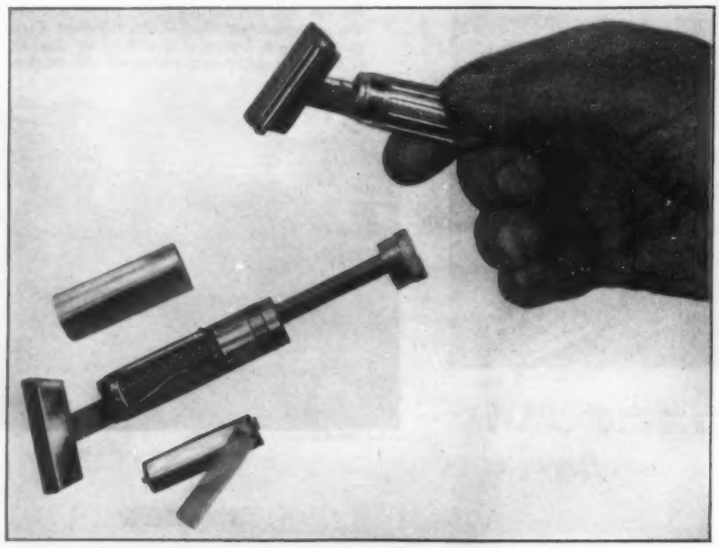
CARBON dioxide is well known as a fire extinguishing agent and many systems have been developed for utilizing it, but up to the present time certain defects have militated against its use. Now however, devices have been perfected to allow the rapid release of pure liquefied carbon dioxide at the point where fire menaces. The great improvement, aside from the new types of valves involved in the releasing of the gas, is a syphon tube extending to the bottom of the cylinder. This allows the liquid carbon dioxide to be forced out instead of causing it to issue in the form of gas.

The new system is largely used for the protection of electrical machinery as shown in one of our illustrations. The upper right-hand picture shows a battery of cylinders filled with liquid carbon dioxide.

In ship-board installations, these cylinders are placed in some convenient place and are connected by pipes to various cargo holds, the engine room, boiler room, et cetera. Means are provided for diverting the flow of the liquid to the proper compartment. Large volumes of the carbon dioxide in its liquid form are obtained instantaneously by connecting the valves by a line or rod so that they can all be opened at once. One of our illustrations shows a pipe located at the mouth of an expansion-hatch of a tanker. This does away with a great menace. Oil fires are extinguished with this system within a period of 30 seconds with absolute dependability and without the slightest damage by the extinguishing agent. Oil fires need not be in confined spaces to extinguish them with pure carbon dioxide. This system will put out oil fires in open tanks exposed to severe windage. The action is so rapid that the fires are quickly extinguished.

A portable hand extinguisher weighing about 35 pounds affords most excellent fire protection. The damage with the use of this gas is practically nil. The liquid carbon dioxide expands into the air at the discharge nozzle, the rapid expansion producing a chilling effect.

Carbon dioxide gas is the "fizz" in soda water. It is used the world over for carbonation of beverages and is therefore obtainable at all of the larger ports. Carbon dioxide is stored in steel cylinders in its liquefied state. The ratio of expansion is one to 500. Therefore the liquefied gas requires a minimum of storage space, piping and weight. Periodic renewal of chemicals is unnecessary as carbon dioxide does not deteriorate. An occasional checking on the contents of the cylinder is made.



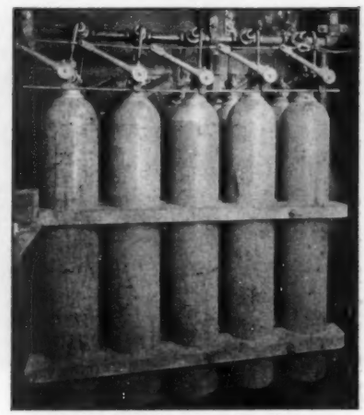
A magazine razor that automatically expels the used blades

A Magazine Repeating Razor

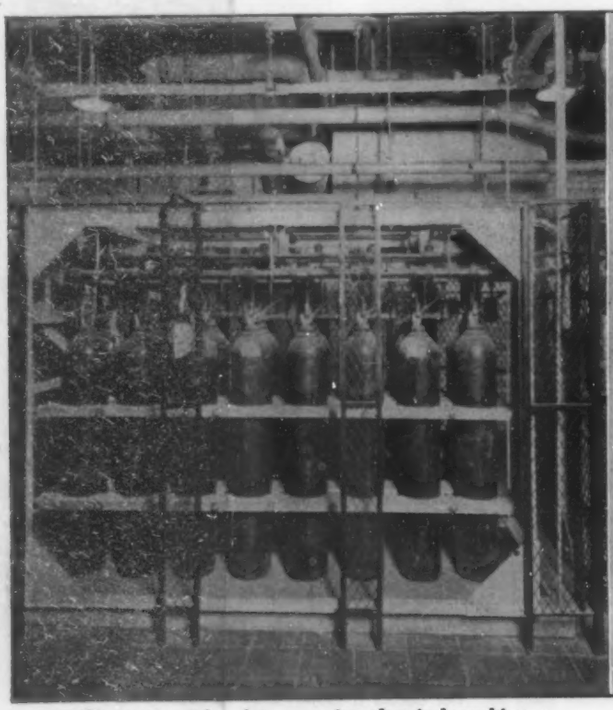
THE razor which we illustrate is not very much larger than a good-sized fountain pen and can be carried readily in the pocket. To operate, the cap is removed, the "shaving head" which carries the blade is tilted up, as shown in our illustration, and after the operation of shaving is completed, it is tilted back and the cap is restored.

The interesting feature about this razor is the fact that twenty shaving blades of standard length are stored in the handle, and are automatically placed in the shaving head as needed, by a pull and push of the plunger. This does away entirely with the necessity of handling thin blades, the removing of protecting papers and the reassembly of the razor.

The blades can be ejected with the speed of a cartridge clip from an automatic pistol. The blades come in clips. The outer covering is removed and the clip, with the blades, slides into the magazine in the handle of the razor. The plunger cap is screwed on and a new blade can be forced from the handle as indicated above. Shaving is never a pleasure, but this device mitigates the discomfort. Refills of twenty blades come in little tin boxes which carry the holder for the blades which are clipped together so that there is no danger of their scattering. This device was invented by a lieutenant-colonel, late of the United States Army.



Fire extinguishers on board ship



Fire extinguisher for protecting electrical machinery

Portable hand extinguisher using liquefied carbon dioxide

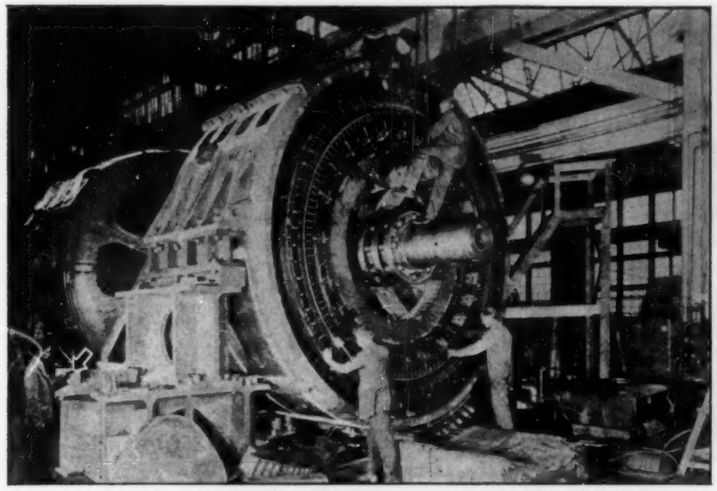
A novel metal egg crate

Butter and Egg Crate

THE illustration above shows a shipping crate for butter and eggs, that holds several advantages. Separate compartments for each commodity insure safety while the crate is being transported. The eggs, placed in the top layer, are separated from each other so as to prevent breakage. They are placed in holders, small end down, and further held in place by wads of soft paper. These crates are supplied in sizes adapted to hold from one and a half to twelve dozen eggs. A convenient slot in the cover is so arranged as to hold an address card and a bill for the goods contained in the box. Stamps may be affixed and the crate mailed.

Motors Great and Small

WHAT is believed to be one of the smallest practical motors is used by the General Electric Company in certain types of demand meters. The motor has a power output of approximately one-quarter of one-billionth part of a horsepower. It is two inches high and weighs only four ounces. The rotor is a thin disk, one and one-half inches in diameter. This type of device is used to drive the "Telechron" clock described in our October issue. In contrast with this small motor, we show one of the largest, rated at 22,500 horsepower. This one is fifteen feet in diameter and has an aggregate weight of 220,000 pounds.



One of the largest motors develops 22,500 horsepower and weighs 220,000 pounds

This small motor weighs four ounces

Home Motion Picture Cabinet

THE outfit for projecting moving pictures, which is illustrated in these columns, somewhat resembles a phonograph cabinet in appearance. An opening in the front wall of the upper compartment is fitted with a translucent panel of ground glass or other suitable material. It is also equipped with doors which cover the panel when closed. In the top of the compartment is a lamp-house from which a strong beam of light is thrown vertically upon a slot over which a film passes, its passage being timed and controlled by suitable mechanism. A revolving shutter cuts off the light from the film at the moment the shift is made from one picture to the next, as in a standard projector.

Moving pictures in the open

The machine in use

In order to obtain projecting distance and the desired enlargement of the picture without increasing the size of the cabinet, the beam of light is reflected back and forth from a series of mirrors before it is finally thrown on the translucent screen. Stationary pictures as well as motion pictures can be shown and there is no necessity of changing the apparatus. At least forty pictures fit on a strip of film a yard long, giving an ample supply for picturing a subject. One can take his own pictures with a small pocket camera and show them in the device.

Protecting Ostrich Keepers

OSTRICHES may have fine feathers, but they have bad tempers, so the device illustrated has been invented to conquer these birds. It consists of a handle six feet long with a fork at the top which carries a strip of brass. When pushed against the neck of a charging bird, an electrical contact is made and the bird is given such a shock that docility results.

Renovating Old Clothes

TO put a fine nap on an old suit of clothes without injuring the fabric, or to raise the nap on original bolts of cloth at a great saving of time and cost, are objects of a recently invented napping machine illustrated here. The device eliminates shine from clothes as far as is possible, in a few minutes. It is a cylinder having 136,000 tiny hooked needles that raise the nap when rolled over the surface of the cloth. The nap on a high-priced suit wears off as quickly as that of a cheap one, but with this invention, all garments can be treated and restored at the tailor shop when being cleaned or pressed.

A Lark Decoy

OUR illustration shows the President of the New York Association of Audubon Societies demonstrating a device of French origin, known as the "lark mill." This artificial bird is actuated by a clock-work motor, and as the wings flap, the mirrors mounted thereon flash in the sunlight and attract many larks. These devices are used where the little birds are desired for food and for the sport of shooting them. Thousands of larks are lured to slaughter every year.

Shocking the ostrich

Taking the shine out of cloth by raising the surface nap

"Lark mill" helps bird slaughter

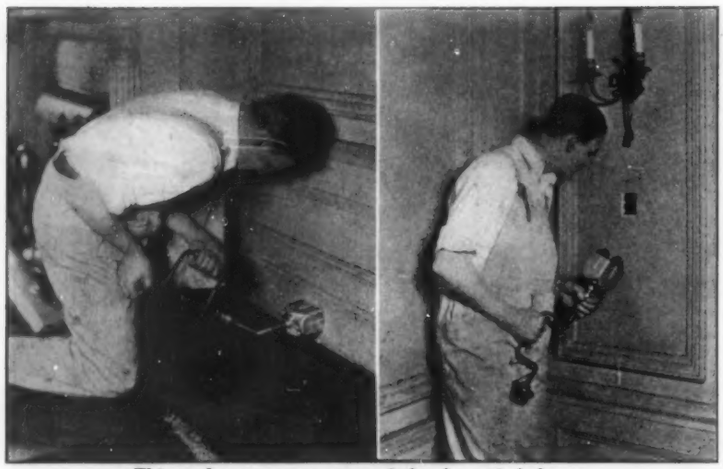
A new convenience for men

A Hinged Cuff Link

THE new type of cuff link illustrated above is provided with a hinge in the connecting bar which makes it possible to pull the hand through the cuff and to raise the cuff on the arm without removing the link.

Cutting Square Holes

THE labor-saving tool, shown in these columns, is useful for making holes for switch boxes. It cuts plaster and wood without damaging the walls or wallpaper. First, it is fastened to the wall by two screws, and is then operated by an electric drill or hand brace. The right-hand illustration shows the protruding circular saws.



This tool cuts square-corner holes for switch boxes

Preserving Anti-skid Grooving

PRESERVING the anti-skid groove on a solid tire tread is a matter of practical importance. The re-groover shown comprises a holder containing a knife and has a handle to guide the cut across the tire tread. Connected to the re-groover is a heavy-duty high-speed electric motor which drives the re-groover knife through the rubber at a rapid rate. The knife is of "V" shape so as to give the proper form of groove and is so regulated that it always cuts to the same depth. Two knives are provided for different depths of groove. The tool is so designed that the knife receives 3,000 impulses a minute.

Solid tire re-groover

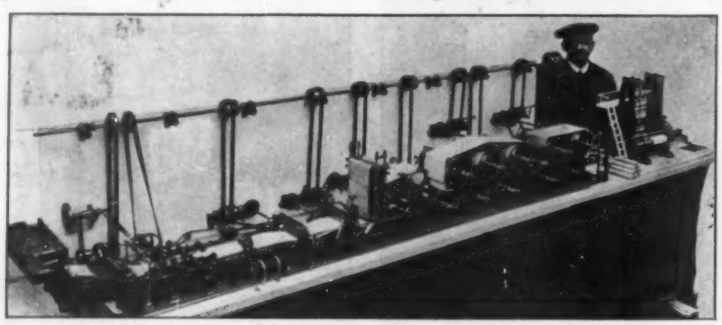
Keeping the clothes pressed

Traveling Bag Clothes Hanger

THE gentleman in the photograph is folding his suit over a fiber form preparatory to putting it in his traveling bag. When he arrives at the end of his journey, he will take the suit out with one motion and hang it in the closet. It will be free from wrinkles. Valet service can be supplied in most hotels but this saves the expense.

Paper Making in Miniature

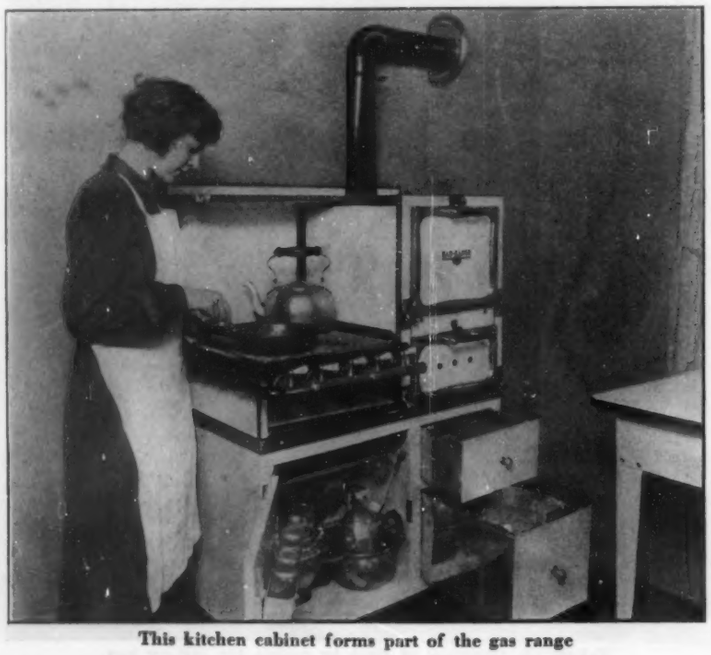
WE reproduce a photograph of a miniature paper machine which was made in France. The construction of the machine was begun in 1902 and finished in 1914. The device received a silver medal at the Lyons International Exposition. It is a complete paper-making machine in every particular. It will make a sheet of paper four inches in width and of any desired length, depending on the amount of pulp which is fed in at the "wet end" of the machine.



Miniature French paper machine makes a sheet four inches wide

A Kitchen Cabinet for the Kitchenette

THE combination of a kitchen cabinet and gas range marks a new era in gas cooking equipment. The food compartment cannot become warm as it is insulated by heavy asbestos. The principle of cool air circulation has also been applied. A tremendous number of steps will be saved in the kitchen by combining these two necessary articles in small kitchen equipment.



This kitchen cabinet forms part of the gas range

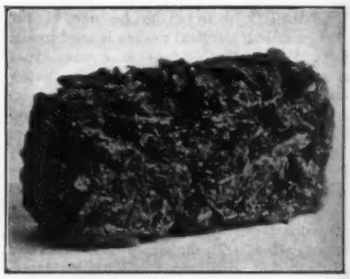
A semi-automatic ice pick

An Economical Ice Pick

AN ice pick that chips ice without waste is illustrated, partially unassembled. The weighted handle, sliding on the blade, acts as a hammer to drive the point into the ice. The pick is carried back, after a blow is given, by the spring within. The pick will not roll if placed on a table as one side of the handle is flat.

Fire Kindler Burns Twenty Minutes

THE illustrated brick of pine chips, pine oil and rosin is designed to eliminate the use of paper, kindling wood and oil, and is particularly valuable for campers who may not be able to obtain dry wood. It can also be used in gardens and orchards or for general singeing purposes and also for basket incinerators. To use the kindler, simply light it and place it, flame down, at the bottom of the grate or in the middle of the fire to be built. Then add lump coal or logs in the usual quantity and a brisk fire is assured. The kindling brick burns for twenty minutes.

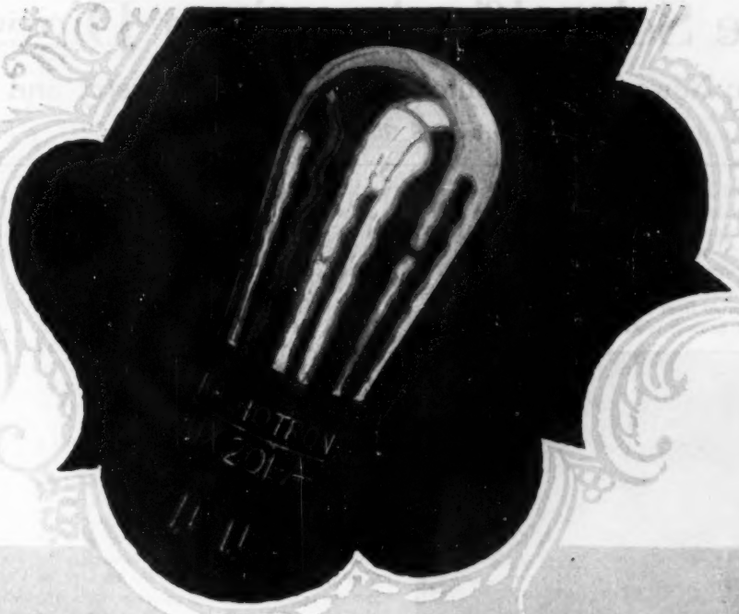


Pine chip fire kindler

A Convenient Magnifying Glass

A NEW YORK inventor has just devised an ingenious holder for a magnifying glass which will be of service to the dentist, the doctor, the jeweler, the bead worker, the embroiderer and the stamp collector. The magnifying glass is supported by a frame secured to a rubber band which slides on the wrist.

Helping out the eyes



look inside that Christmas Radio Set

THE *equipment* is as important as the set. The distance reach of a set depends a great deal on the tube in the detector socket. The over-all performance of a set depends very much on the tubes in every socket. The volume and tone quality you will get are dependent upon the tube in the last audio stage. In every point, the tubes are as important as the set. And everyone who realizes this insists on genuine RCA Radiotrons.

The research laboratories of RCA, General Electric and Westinghouse have developed Radiotrons to new accomplishment, year by year. And the manufacturing skill of these same companies keeps RCA Radiotrons far in the lead in accurate making. There are few manufactured things in the world as delicate as a vacuum tube. And there are therefore few things in which it is so important to get the best.

Be sure, when you buy a Christmas radio set, that you are getting genuine RCA Radiotrons with it. You can tell by the RCA mark inside the glass at the top. Or take out the tube, and look at its base.

Extra! Extra! Gift Ideas for Radio fans

A "spare" Radiotron—genuine RCA Radiotron, of course—of the type he uses.

A *power* Radiotron UX-112, UX-171 or UX-210 for bigger volume and finer tone.

A special *detector* Radiotron UX-200-A for storage battery sets—for longer distance reach.

Ask any dealer all about these Radiotrons—he'll tell you which to get. But be sure it's a genuine RCA Radiotron, if it's to be worthy of gift giving.

RADIO CORPORATION OF AMERICA
New York Chicago San Francisco

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Motor Trucks That Run on Wooden Rails

A ROAD made of heavy poles, on which trucks, equipped with special wheels that will not run off, are driven, is the solution to the bad-roads difficulty in a forest area in Oregon, where large-scale lumbering operations are carried on. These trucks can-

Traversing an open space. The wooden track wears and splinters but more timbers are cheap and easy to obtain and lay in position

not lie down in the deepest mudhole in the world, like balky Missouri mules, and defy their owners to move them, for they run on tracks which resemble railroad tracks. They steer themselves.

Due to the heavy rainfall in Coos and Curry Counties, in southwestern Oregon—which averages 72 inches annually—motor trucks can be used in the extensive logging industry only about 100 days a year. Even during this period, the 2½-ton auto trucks that are commonly used are too heavy in many instances. This means that the average load hauled is only 2,000 board-feet of logs.

To overcome the adverse weather conditions a truck manufacturer has designed and manufactured, for the Western White Cedar Company, a 3½-ton tractive unit and a four-wheeled trailer provided with 18-inch flanged wheels. This enables the lumber to be hauled on a road constructed entirely of logs.

This special truck is equipped with five forward and five reverse speeds. In high gear, it will run at a speed of five miles an hour. As the flanged wheels fit perfectly to the poles, the steering apparatus is disconnected, thus allowing the driver ample opportunity to fix chains and see that his load is secure while the unit is in motion.

The unique road is formed of poles laid lengthwise like rails and supported underneath by heavy cross-ties which prevent slipping and rolling. This roadway permits the lumber company to move their logs any distance from the woods to the river at a low cost.

When loaded, the trucks can traverse grades as great as 4½ percent, and when unloaded they can climb grades which average, at times, 7½ percent. Unusually heavy loads are hauled by this method, 8,711 board feet of lumber having been moved at one time. The average daily haul is 35,000 feet. This was made in seven trips of a mile and three-quarters each.

Ninety cents a lineal foot was the remarkably low cost of constructing this road—and 25 cents a thousand feet for the lumber hauled over it is figured as the cost of maintenance. It is estimated that 15,000,000 feet of logs may be hauled before it becomes necessary to replace the poles. Already over 4,000,000 feet have been transported from the forests to the river. The cost of hauling is $1.50, and the loading cost is 75 cents a thousand feet. When 8,000 feet are hauled, this represents a weight of 28 tons, while the weight of the equipment is nearly seven tons.

* * *

Character Reading by Face All "Bunk," Say Scientists

TIME was when tall, blond, blue-eyed men were considered to be the epitome of all the manly virtues of courage and initiative. To the small dark types, on the contrary, were attributed the less positive qualities of timidity and reticence.

Modern science, however, now comes along and demolishes this theory. Psychologists have turned the battery of inquiry on the precepts and principles of professional character readers and pronounce the whole matter of character analysis based on physical traits as having no foundation on scientific fact. In other words, it is all "bunk."

Prof. G. C. Brandenburg of the Department of Psychology of Purdue University, Indiana, has collected the results of these investigations of the self-styled character experts in a report shortly to be published in *Industrial Psychology*. Prominent in his account is a résumé of a tryout of the so-called color law evolved by a very well-known worker in this fertile field. The law states that blondes possess the dynamic traits that make the world's leaders, pioneers, and explorers, while the brunettes have the negative conservative and thoughtful qualities that make writers, research workers and investigators.

Over 90 disinterested persons were each asked to give character ratings of two blondes and two brunettes of his acquaintance. Examination of the details in the character ratings failed to show any constant differences between the two types, compared on the basis of the color of their hair. "Blondes were found to possess brunette traits to the same extent as the brunettes and vice versa," declared the investigators.

Prof. H. D. Kitson of Columbia University and G. L. Donham of Indiana University undertook to check up the contention, stoutly upheld by many character readers, that weight and size are necessary assets in salesmanship. Some two hundred salesmen were examined and their respective sizes and weights compared with their selling records. On completion of the test, it was found that the best salesmen were not, on the average, the tallest nor the heaviest, but were the men of medium size averaging around five feet nine inches with proportionate weight.

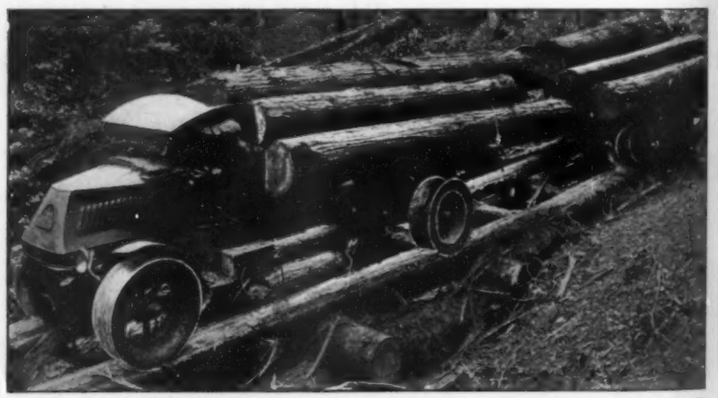
'Even the significance of the profile, long a favorite character guide with almost everybody, is not allowed to go unassailed. No longer is the convex type with the prominent forehead and square jaw to be associated exclusively with the strong silent man of initiative and power nor the concave type with the more or less receding chin to be thought of only in connection with the patient, docile underling. Examination of a hundred students, checking up the judgment of their intimates with their college records, shows that there was only a preponderance of 2 percent of the boys with the convex type of profile who displayed marked qualities of leadership.

In commenting on the researches of his colleagues, Professor Brandenburg declares that "in the light of critical studies on the question, we must conclude that as a method of character analysis the physiognomic system is wholly devoid of any scientific basis."
—*Science Service.*

* * *

New Synthetic German Petroleum

A NEW method of cheaper synthesis of a high-grade motor fuel in Germany may go far toward the solution of the motor-fuel problem in the future. The Berlin professor, Franz Fischer, who recently devised means of making liquid fuels synthetically from coal products has now simplified his process so that he can dispense with costly high-pressure apparatus that has stood in the way of its commercial development.



Hauling a heavy load through the forests of southwestern Oregon. The load on the trailer is nearly as great as that on the truck

The new method produces a pleasant smelling gasoline as clear as water and one which will not harden or become gummy on exposure. The gasoline is highly volatile and is largely made up of unsaturated compounds like olefines which impart to the gasoline valuable anti-knock properties. This enables it to be used in efficient high compression motors without objectionable knocking and with great economy.

A number of valuable by-products may help to put the process on a sound commercial basis in the future. Certain substances of high boiling point condensing to heavier oils, may, by the use of catalyzing agents, be changed to hard paraffine. The purified crystallized substance could be used in the manufacture of candles and other paraffine products, it is claimed.

Semi-coke, a new industry by-product for which a commercial use has not yet been found, may be used as the basis of synthesis of this new gasoline. Semi-coke is left over in the low temperature carbonization of coal in the making of tar oils. In the Fischer process water-gas from which the new liquid fuel is condensed can be made from coke or semi-coke, and the latter, it is claimed, would be an ideal starting material.

Coke and coal are almost completely gasified when steam is led over them at a high temperature, and water-gas, a mixture of carbon monoxide and hydrogen, is formed. If this water-gas could be transformed entirely into liquid motor fuel, the problem of the wasteless transformation of solid coal into liquid fuel, the dream of the modern chemists, would be accomplished.

The Badische Analin und Soda Fabrik first succeeded in commercially synthesizing liquid fuels from this gas mixture in Germany by means of Dr. Fischer's early method, in which pressures of 1,500 pounds per square inch or more were employed.

By his new process, however, Professor Fischer has succeeded in synthesizing gaseous, liquid and solid carbohydrates from carbon monoxide and hydrogen at ordinary pressure. Hitherto all reduction of carbon monoxide without pressure yielded methane, but Fischer found that by using an iron-zinc oxide catalyzer, more complicated products were formed. Other metals and their compounds were studied and a cobalt-chromium oxide mixture was found to stimulate the formation of gaseous, liquid and solid carbohydrates, when heated to about 518 degrees Fahrenheit.

The carbon of the carbon monoxide is said to be made into carbide by the metal, and the carbide then split by the hydrogen in the gas mixture. As a result the metal is regenerated and carbohydrates are formed.

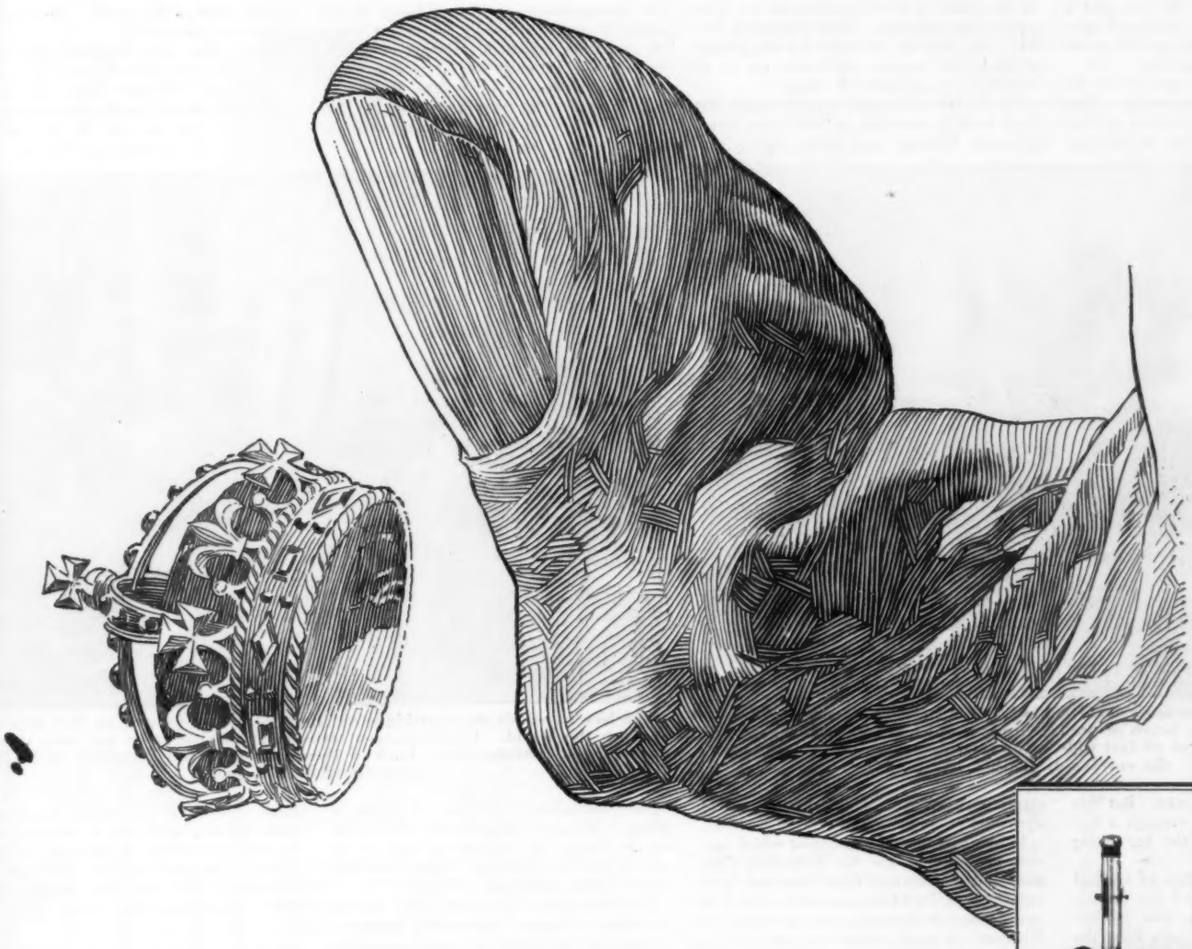
In the old Fischer method a large proportion of the synthetic products formed were highly oxidized, but in the new normal pressure process they are unoxidized. Professor Fischer found that if the temperature was raised, the formation of higher carbohydrates stopped and methane was again formed.—*Science Service.*

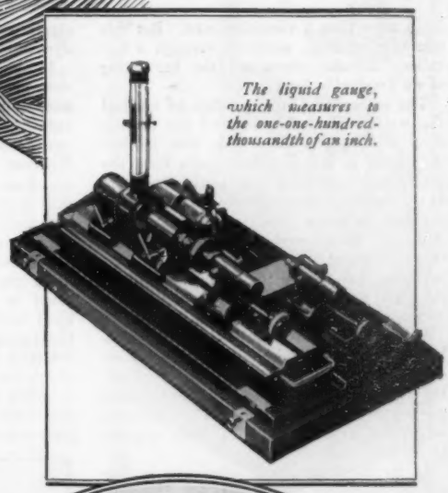
* * *

Liquid Oxygen Explosive

INTENTLY at work in his laboratory some fifty years ago, a French scientist, Louis-Paul Cailletet, inadvertently opened the wrong valve in a whirring apparatus before him—and made history by doing it.

(Continued on page 448)





The liquid gauge, which measures to the one-one-hundred-thousandth of an inch.

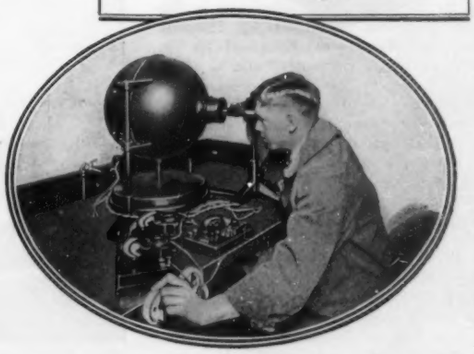
The "rule of thumb" *is over . . .*

KING THUMB rules no more. The rule of thumb, with all its costly guesswork, has no place in Western Electric telephone making.

Here exact measuring standards are the rule, precise in many cases to the ten-thousandth part of an inch.

And this habit of being exact controls every factory activity—in the systematic planning of the great task of telephone production, in manufacturing to known standards of quality, in constantly improving methods of work—not in haphazard experiment but by scientific attack by a group of skilled industrial engineers.

At the same time, as makers of the nation's telephones, Western Electric is meeting its responsibility by holding down the cost of telephone apparatus to a figure well below the increased cost of general commodities.



Looks like a bomb, but really a little "dark room" which permits the inspector to know exactly whether a tiny switchboard lamp comes up to the mark.

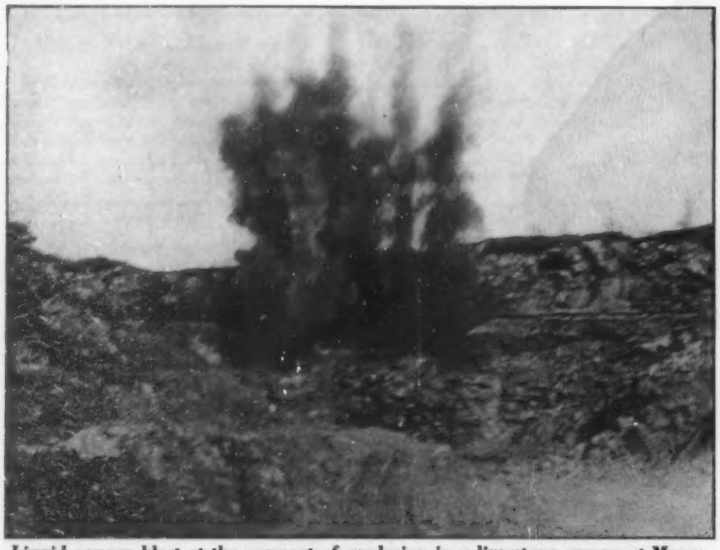
Back of your telephone

Western Electric

SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM

Nothing exploded, there was not even a sputtering spark, but what happened gave Cailletet the thrill of his life and the scientific world a portentous discovery.

In an ordinary glass tube upon which the Frenchman had fixed an expectant gaze during years of experiment, he espied a drop of moisture. It lingered but a moment, little more than a vanishing mist. But this one vagrant drop, produced through a fortuitous mistake, signalized the harnessing of an invaluable force.



Liquid oxygen blast at the moment of explosion in a limestone quarry at Myerstown, Pennsylvania. The bench in the foreground, which is torn asunder by the blast, was 30 feet high and 60 feet wide. The cartridges were set 28 feet below the surface of the bench

The box in which the cartridges are first soaked in oxygen so that they may absorb the liquid. Liquid oxygen transportation containers are seen standing around the cartridge box. Each of these large cans has a capacity of 15 liters, approximately 15.8 quarts

The enthralled Cailletet, when he touched the wrong valve and observed the fleeting drop of moisture, knew only that he had discovered a way to reduce gases from the air to a liquid form and bottle them up. It remained for scientists years later to find out how to utilize this concentrated power. Although the every-day world up to this time has heard little of liquid oxygen, this substance has, within the last decade, taken its place as one of the notable discoveries of modern industry.

Liquid oxygen is literally air reduced to liquid form, from which, in process of powerful compression, nitrogen is distilled off. In the alternating process of compression and expansion through which it is produced, it reaches a temperature of 269.5 degrees below zero Fahrenheit.

In its quiescent form, when not in use as an explosive, liquid oxygen instantly freezes all substances immersed in it. Poured on ice, it vigorously boils, so much warmer is the ice than it. Flowers dipped in it will become frozen to the rigidity of porcelain. An appetizing, tender steak will become so tough and solid under its effect that it may be used as a hammer.

Liquid oxygen explosive, or "L O X" as it has come to be known, is made by mixing very finely divided carbon, which is in the form of lampblack or carbonblack, with the liquid oxygen which is, of course, highly concentrated oxygen. The association of the carbon and the oxygen is so intimate that when combustion is started, due to a fuse or detonator, the carbon instantaneously burns and creates a large volume of highly heated carbon dioxide gas.

At the moment of combustion, or explosion, the temperature of liquid oxygen jumps from 269.5 degrees below zero to 5,603 degrees above Fahrenheit, a range of 5,872.5 degrees. The shattering force of this combustion is sufficient to rend asunder huge strata of rock.

The practicability of liquid oxygen as an explosive has been put to test by the United States Bureau of Mines. It has been found particularly advantageous for blasting rock in quarries or in other open rock formations. During the war, when the Germans ran short of glycerine and Chilean nitrates, they found it imperative to evolve a substitute for dynamite as an explosive. Their engineers, who had been working for years on the process of liquefying oxygen, put it into use as an explosive in underground mines.

In the last few years, liquid oxygen has been used in quarrying in New York, Pennsylvania, Colorado and other states, with significant results as compared to the use of dynamite.

In one conspicuous experiment which was recently made by the Air Reduction Company and the Ingersoll-Rand Company sixty cartridges of liquid oxygen were placed in twelve holes 28 feet deep and six inches in diameter. A single trunk fuse was used to set off all the cartridges simultaneously. The drill holes were set 12 feet apart, in a 30-foot rock bench.

The cartridges, fitting snugly, were 18 inches long and 5½ inches in diameter, five being placed in each hole. They were encased in bags made of stout muslin and filled with finely divided carbonaceous material of a highly absorbent nature.

Out of 1,014 pounds of liquid oxygen into which the cartridges were dipped, each one absorbed 15 pounds, or 940 pounds for all. Since the cartridges were immersed in relays, one hour and a half elapsed from the time they were dipped until they were placed in the drill holes. This fact is pointed out by engineers as emphasizing that, even with a relatively rapid evaporation of liquid oxygen, sufficient time may be taken for deliberate placing of the cartridges, so as to obtain the most effective results.

The safety of blasting with L O X is one of its characteristics, recognized officially by the Bureau of Mines. Its cartridges cannot be set off except by a very severe shock such as the impact of a bullet. The Bureau of Mines says of it: "No danger exists in the transportation of this explosive to the point of use. Practically no danger exists of premature explosion. Danger of misfire in event a cartridge is not properly exploded is eliminated by waiting a sufficient time to allow for the evaporation of the oxygen. (The time necessary depends on the diameter of the cartridge.)

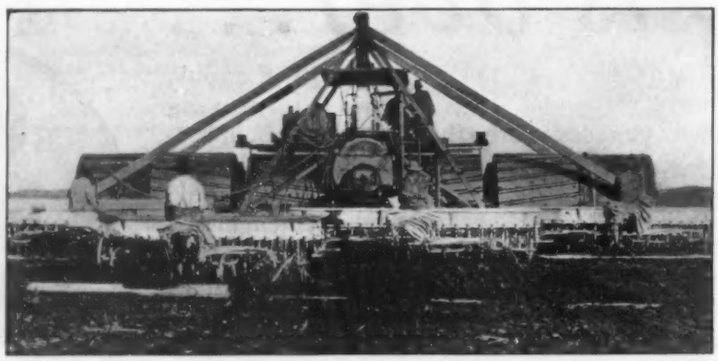
"An unexploded stick of dynamite is always a menace if encountered while mucking or during the removal of coal or ore from a mine, but the liquid oxygen cartridge, under similar conditions, is 'dead.'"

In Europe there are many plants producing liquid oxygen. One mining company, in Lorraine, is mining its entire output of iron ore by liquid oxygen explosive, and it is estimated that fully 80 percent of the iron ore mined in France is being blasted with L O X. New liquid oxygen plants are now being built in this country.

* * *

Forerunner of the Caterpillar Tractor

PROBABLY in no part of the world were the limitations of the old steam tractors more keenly felt than in the soft, reclaimed peat lands of the San Joaquin and Sacramento River deltas of California. These lands were very soft—so yielding, in fact, that it was necessary to provide broad wooden shoes for the horses.



The old steam tractor, built in 1898, whose bulk and unwieldiness induced Benjamin Holt to invent the crawler tread

The early-day manufacturers attempted to meet these conditions by constructing tractor wheels of great width. About 1898, Benjamin Holt of Stockton, California, built a tractor (shown in the accompanying illustration) for Charles Moreing, a delta landowner. This machine had wheels eight feet in diameter and 18 feet in width.

The difficulty with this enormous engine was that the weight increased in proportion to the width of the wheels. Therefore, little advantage was gained.

About this time Benjamin Holt realized that an entirely different principle must be worked out. He built a pair of tracks or "platform wheels," as he then called them, and tried them on one of the old steam tractors. The materials for this first crawler tread came from the scrap pile about his shop, but the result was so satisfactory that he was encouraged to continue his experiments. The next attempt was still more successful—and thus the modern "caterpillar" tread came into being.

* * *

Effect of Milk on Weight and Height

MILK for growing boys and girls is a universal slogan, but actual experiments to prove its value have produced figures that astound even the medical authorities.

Dr. H. C. C. Mann has just reported to the British Medical Research Council the results of one of the most extensive nutritional experiments ever undertaken. It lasted four years and involved over 500 boys. This investigation has demonstrated that the addition of a pint of milk a day to a diet that satisfied even a growing boy's appetite brought up the yearly average gain in weight from 3.85 pounds to 6.98 pounds and increased the gain in height from 1.84 to 2.63 inches.

The boys used as subjects for the experiment, mostly foundlings who had previously been examined to exclude the possibility of disease, were housed in cottages in a suburb outside of the city. Living conditions and discipline were excellent, according to Dr. Mann, while short vacations and absences assured almost continuous observation throughout the whole period.

The boys were divided into different groups, one of which received only the basal diet that was planned to meet the demands of the child of school age. This dormitory fare was judged by physicians to be equal and even slightly better than that customary in working-class homes, while periodic physical examination of the boys in this group showed them to be in good physical condition.

To find out what classes of food would produce the most increase in height and weight, other groups were each given extra rations of sugar, fresh butter with a high vitamin content, fresh cow's milk, vitamin-deficient margarine and concentrated protein equal in food value to the meat in the regular diet.

The milk and butter groups were found to make the largest gains, the boys who had the pint of milk being far in the lead with

(Continued on page 450)

NEW LIONEL SWITCH TOWER No. 437
NEW AUTOMATIC SEMAPHORE No. 80 & 080
ELECTRICALLY LIGHTED PULLMAN CARS
TELEGRAPH POST No. 60
AUTOMATIC TRAIN CONTROL No. 78 & 078 Patented
LOCOMOTIVE (Electrically Controlled Twin-Motor, Reversible) No. 402 E
AUTOMATIC CROSSING GATES No. 77
AUTOMATIC WARNING SIGNAL No. 69

As if by Magic!

—you can run your "Lionel Standard" Train at various speeds, stop it and reverse it by manipulating a small lever placed at any distance from the track. *As if by magic*—your Lionel Automatic Train Control will start and reverse your Lionel Train without being touched by hand, and *as if by magic*—you can switch your "Lionel Standard" Train from track to track with the new Lionel Electric Switches by manipulating another small lever placed at any distance from the track... Lionel trains and equipment have been "Standard of the World" since 1900. And now, after years of experiment, Lionel engineers have accomplished the greatest achievement in the history of model railroading by creating

The New Lionel 100% Electrically Controlled Railroad

for "Lionel Standard" track.

Lionel makes the most complete and perfect line of model Passenger and Freight trains in the world,—both electrically-controlled and hand-controlled for "Lionel Standard" track; and hand-controlled for "O-Gauge" Track. Lionel Trains are *real* in everything except size; every piece beautiful in design, perfect in construction, and fully guaranteed. They contain hundreds of improvements and refinements not found in other lines. Yet Lionel Trains are the lowest in price consistent with supreme quality. *You can buy a Lionel "O-Gauge" Train for as low as $5.75!*

See the wonderful Lionel demonstrations at the leading Department, Toy, Hardware, Sporting Goods and Electrical stores.

Send for the NEW LIONEL Model Railroading Book—It's FREE!

This fascinating 48-page book illustrates in actual colors hundreds of Lionel Model Trains, Automatic Railroad Equipment and "Multivolt" Transformers.

Send for it today! Write to Dept. 29

THE LIONEL CORPORATION

15-17-19 East 26th St., New York City

Lionel All-Steel Electric Lamp Posts

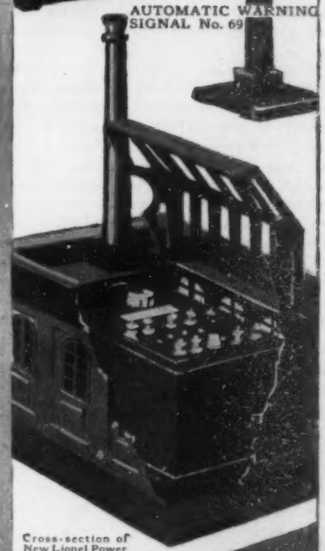
Illustrating three of the many styles in the extensive Lionel Line.

Lionel Coal Car No. 216

Equipped with automatic couplers and hand brakes. Has "Hopper" bottom operated by wheel on side of car. Just one of the complete line of Lionel freight cars, of all types and sizes.

Lionel Oil Car No. 215

Another striking number in the new series of Lionel Freight Cars. A real oil car in miniature.



Cross-section of New Lionel Power Station — showing Lionel "Multivolt" Transformer

NEW LIONEL ELECTRICALLY CONTROLLED SWITCH No. 222
"LIONEL STANDARD OBSERVATION CAR Showing Dome Light and Rear End Lanterns

"STANDARD OF THE WORLD SINCE 1900"

LIONEL ELECTRIC TRAINS

MODEL RAILROAD ACCESSORIES

"MULTIVOLT" TRANSFORMERS

an average gain of nearly seven pounds a year and over two and a half inches in height. Casual visitors easily picked them out as "being obviously more fit than the others." The whole group enjoyed exemption from illness, Dr. Mann stated, when sickness in the other houses was more prevalent than usual.—*Science Service.*

* * *

Tornadoes Started by Oil Fire

TORNADOES, smaller than the twisters that often work havoc in the Middle West, but true tornadoes just the same, were one of the effects of a great oil fire at San Luis Obispo, California, recently, according to a report to the United States Weather Bureau by J. E. Hissong, of the local weather bureau of the California city.

The fire was started by lightning and burned for five days, destroying nearly six million barrels of oil. Two persons were killed and the total property loss was estimated at 15,000,000 dollars. However, the unique feature of the fire was the great number of tornadoes which it started, one of which was responsible for the two deaths.

Before these whirls started, says Mr. Hissong, strong southerly winds prevailed, which shifted to west and then to northwest. Then four tanks, each containing 750,000 barrels of oil, "boiled over."

"They threw out an immense quantity of hot, burning oil," he says, "which spread with remarkable rapidity over an area estimated by the engineers present at about 900 acres. The flames seemingly leaped a thousand feet into the air. At the same time violent whirlwinds began to form over the fire.

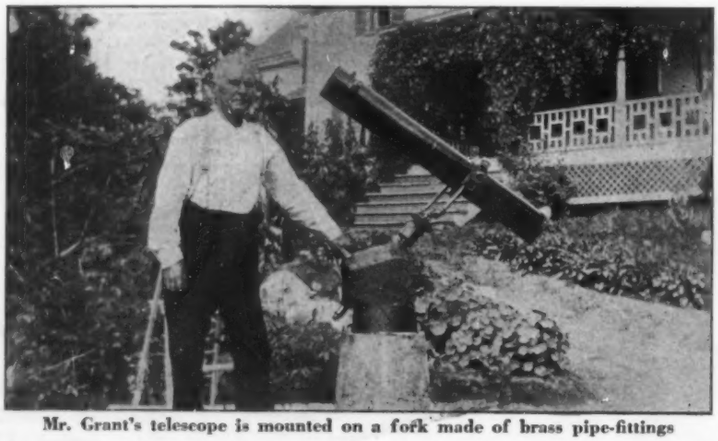
"From the time the wind veered into the northwest and the large reservoir boiled over, hundreds of whirlwinds formed in and around the edges of the fire until the last tank boiled over. During the period when the large reservoirs were burning and the temperature over the fire was probably at its highest point, and consequently the vertical convection was strongest, the whirls appear to have been most numerous and violent.

"Many of them had all the characteristics of true tornadoes. The gyrating, writhing, funnel-shaped clouds with the white condensing vapor in the vortices were plainly visible against the background of black smoke. Some of the funnels appeared to be not more than one foot in diameter at the smallest part, and some were reported as giving the impression of ropes dangling from the clouds of smoke."

It was one of these twisters that caused the casualties, for it left the fire, traveling east-northeast to a cottage about a thousand yards away. It picked up the cottage, lifting it several feet in the air and carried it about 150 foot north. There the cottage was dropped in a field, a total wreck, and the owner and his son, who had been in it at the time, were killed. A few minutes later a whirl, which Mr. Hissong believes might have been the same one, unroofed a house about a quarter of a mile northeast of its first victim. Debris, evidently carried by other whirlwinds, was found as far as three miles from the fire.

Since the whirlwinds started just after the wind veered, Mr. Hissong suggests that they may have been caused by the convectional currents over the fire being started rotating by the northwest wind.—*Science Service.*

* * *



Mr. Grant's telescope is mounted on a fork made of brass pipe-fittings

Maine Quarryman Makes Telescope

IT is always a source of keen interest to the telescope editor to observe the many ingenious ways by which the amateur telescope makers work out the essential parts of their mountings. Mr. James Grant, the owner of a quarry at Hall Quarry, Maine, sends us the following description of his telescope, made from the instructions published in "Amateur Telescope Making."

"I ground and polished the mirror myself, following the instructions given in your book, 'Amateur Telescope Making.' I am therefore obliged to you for enabling me to build this six-inch, four-foot telescope and for giving me an opportunity to indulge in the most interesting and instructive field of amateur work an individual can take up.

"Like many others, for years I had a desire to possess a telescope, and when Mr. Porter's articles appeared in the Scientific American I immediately began assembling equipment for the grinding and polishing of a six-inch mirror. In the cellar of our house I placed two weighted barrels, one in one part of the cellar for grinding, and the other in an enclosure having a solid floor and bench. This room was used for polishing and testing by the Foucault knife-edge test.

"You would not have space for the details of my adventures in grinding and in making and using the pitch lap for polishing the mirror. Sometimes amusing, often rather discouraging, tribulations and trials were my lot, all of which were, however, overcome with gratifying results. To me the delightful interest derived from testing alone repaid me for all the work in grinding and polishing.

"Having tested, and finding results as shown by illustrations in the book, I was delighted. But fearing nevertheless that I might not have the mirror just right I sent it up to Mr. John M. Pierce of Springfield, Vermont, who kindly looked it over and returned it to me, pronouncing it a 'peach.'

"I built a simple mounting along the lines described by Mr. Pierce and Mr. Porter in the book. The foundation of the mounting is of concrete, the upper story in the shape of a New England church, the steeple inverted to make the polar axis. A one-inch iron pipe was imbedded in the concrete. In this a ¾-inch brass pipe about 18 inches long revolves. The mount I chose was the English type, the fork being made of ¾-inch brass pipe. The center of the fork is a pipe tee. Two nipples, two elbows and two short pieces of pipe complete it. On the end of each side of the fork there is a tee into which a ½-inch iron pin from the 1½ inch x ¼ inch flat iron band on which the 4 foot galvanized iron tube is hung, is inserted.

"The overhang is regulated and controlled by a mechanical contrivance made from the pinion wheels of a discarded electric blasting battery which we used in the granite quarries. I would have liked to show this device more plainly in the picture as I find it easy by this means to control the telescope in finding any object in the heavens. It also enables the telescope to be held rigid when the object is found, and gives excellent results."

* * *

"Radio-Operated Furnace"—A Correction

IN our description of the radio-operated furnace, August issue, page 135, we inadvertently stated that "licenses were issued by the Government . . . . permitting manufacture." As a matter of fact the licensing of this apparatus is controlled by the Ajax Electrothermic Corporation.

* * *

A Graphic Sketch of Arctic Perils

A FACT not known to the average person is that Oxford University has sent three exploring parties into the arctic regions. Therefore, "With Seaplane and Sledge in the Arctic" (George H. Doran Company, New York) should prove of value to those who are interested in that great area at "the top of the world."

This new book, contrary to the usual records of exploration, is a most interesting volume. It gives a brief résumé of the 1921 and the 1923 expeditions and deals in complete detail with the one that went forth in 1924. The story of the trials and tribulations of the party are couched in such language that the reading of it becomes a treat rather than an educational duty.

The 1924 expedition was concerned chiefly with the exploration of North-East Land and so the records deal with the findings there. At the same time, the author, George Binney, leader of the party, manages to include many personal touches, some of them gleaned from the diaries of the various members of the expedition.

The appendices are also an interesting part of the work and their inclusion was certainly a happy thought. In them, one will find much interesting datum. For instance, if the reader wants to spend a few months in arctic exploration, the information in the appendices will prove invaluable. Costs of equipment, the arrangement of the press and film rights, members' contracts and other important details are dealt with. All in all, this record of exploration is a notable work.

Courtesy of the United States Weather Bureau

Formation of a tornado cloud over an oil fire at San Luis Obispo, California. This phenomenon took place on April 7, 1926

Courtesy of the United States Weather Bureau

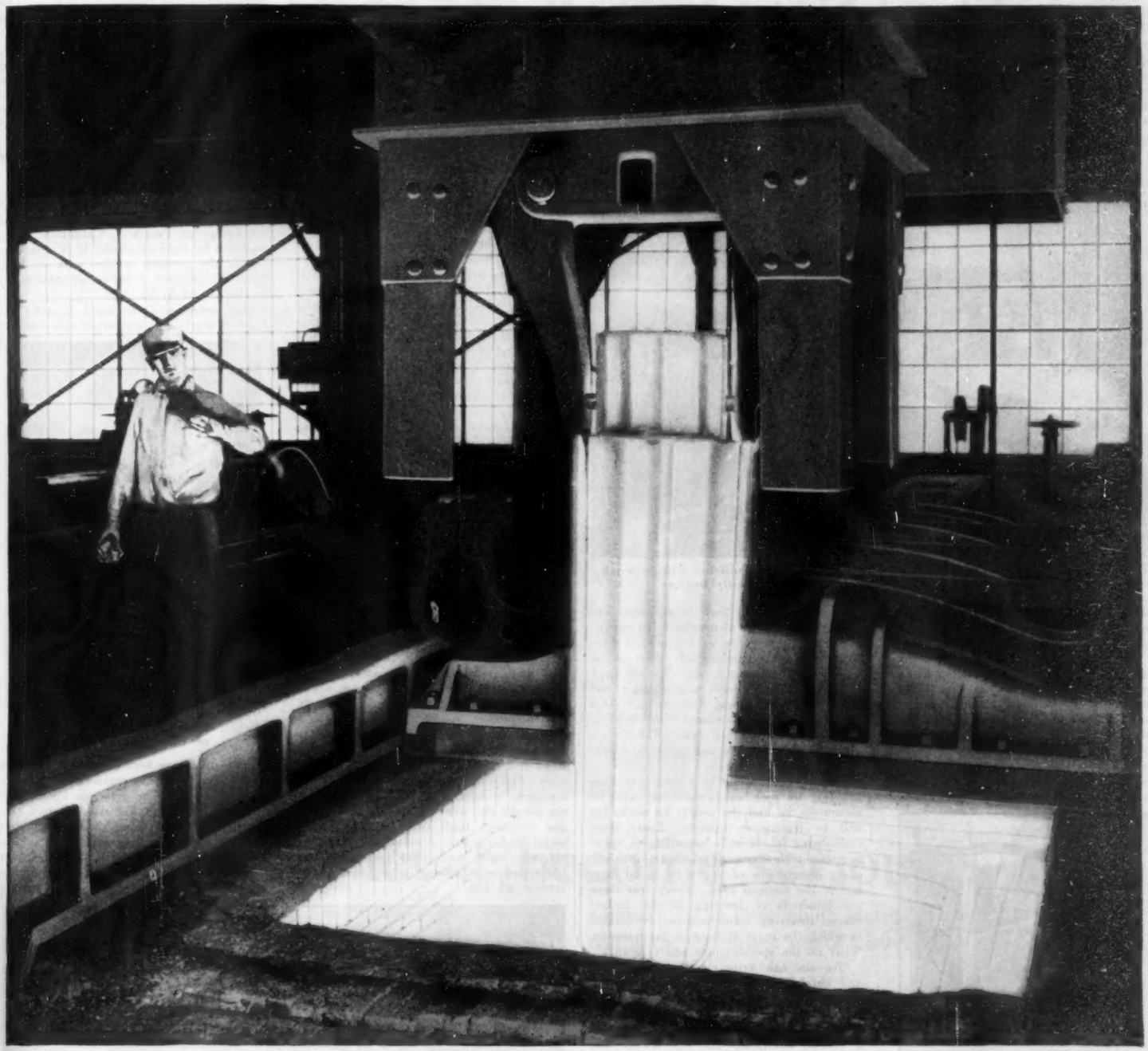
This photograph was taken subsequently to the one at the left. It discloses the further development of the tornado cloud

Glass That Will Not Splinter

THE production of safety glass of various types has been attempted before in the United States. Its drawbacks to date have been either that it had reinforcing wires that do not favor clear vision, or that it took on a yellow tinge with time, which had an obscuring effect.

Triplex safety glass is new only in the United States. It has been made and widely used in England since 1914. It has absolutely clear vision, with no discoloration.

(*Continued on page 452*)



The giant fingers of a massive overhead crane manipulate 4250-pound ingots of glowing steel above the fiery mouths of the re-heating furnaces in the Timken steel mill

Durability Where Your Car Needs it Most

You would hardly think of buying a car or truck without testing its performance. How you would appreciate a way to test the *permanence* of that performance. You can tell much from the presence of Timken Bearings.

The *material*—Timken electric steel—is the most enduring steel for carrying motion. It is made in the Timken steel mill—with the world's largest output of electric steel.

The *design*—tapered *POSITIVELY ALIGNED ROLLS*—gives greater thrust and radial capacity, crowds friction to the vanishing point, saves power, and conquers wear.

Supreme in both material and design, it is little wonder that Timken Tapered Roller Bearings are dominating industry—standard in all types of industrial machinery and in 91% of the motor vehicles made in America.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

Actually, it is two sheets of the finest plate glass, with a middle layer of pyralin. The three layers are pressed together under heat, and at a pressure of 1,500 pounds per square inch. Due to this enormous pressure, the plate glass will crack and be destroyed in manufacture if it has the slightest irregularity on the surface. Hence the makers go to Czecho-Slovakia for the best plate

Passenger car equipped with triplex safety glass, after a collision with a truck. Passengers in the car were uninjured, receiving only bruises

glass obtainable. Preparations are now under way, however, to make such glass in the United States.

Under a very heavy blow, this glass gives way but does not shatter or splinter. Consequently it cannot cut anyone. Three-quarters of the injuries in auto accidents come from flying glass; and jewelry store thieves thrive on common plate-glass windows. In these two fields lie the most obvious uses for this safety glass. It is also widely used for eye-protection in industry, on common carriers such as subways and

Diamond display case, hit with a heavy hammer by a man standing six feet away. A hole is broken through the glass, but a flap of glass still hangs over it. If a man could insert his hand, he could not remove it, due to the flap

buses in England, on airplanes, et cetera. It can not be cut with a diamond. It was triplex which Mussolini ordered for his cars after the recent bomb attack.

* * *

What Does an Engineer Do?

"LAST spring," said President A. E. Morgan of Antioch College recently, "one of our freshman students was failing in his work, and we asked him in for a talk. This is the substance of what he told us:

"'I have lost interest in my studies because they do not prepare me for my life work. I want to be an engineer, and here I am, near the end of my freshman year in college, and I know no more of engineering than when I came.

"'I have been kept at chemistry and mathematics and English and physical education, and such things, when I want engineering. Out on my cooperative job,' [the students spend half time at college classes, and half time in practical work, changing every five weeks] 'I am simply a workman in a construction crew. I suppose an engineer planned the work, but I had nothing to do with that part.'

"This boy expressed what a million other boys and girls feel. They want to get at their life work, and they do not want any unnecessary matters to interfere. In twenty-five years of work as an engineer, I have come to know something of what an engineer is called upon to do. We all know that an engineer needs mathematics and physics and mechanical drawing and other subjects as closely associated with his work, and I will not discuss them. I will talk about matters that do not seem as closely related to engineering.

"An engineer should be a master of English. If he uses words carelessly and inaccurately, he and the people he works for will be forever in trouble. Every large engineering job is built 'according to specifications.' These specifications are detailed, exact descriptions of the work to be done and of the material used. Every year there are hundreds of lawsuits in the United States, involving many millions of dollars, in which the point at issue is the question, 'what do the specifications really mean?'

"No one can write clearly without long and careful practice. There has been a prejudice against English among engineering students, and as a result many of their specifications are badly written. Possibly a shrewd contractor and his lawyer will read these over word by word and sentence by sentence, and will find some loophole by which they can escape doing the work as intended, or can collect more money for it than was intended.

"A journalist may get along with careless writing, but an engineer cannot. Very few men have their words read so carefully and so critically. A slip in using the word 'and' instead of 'or' may cost the engineers' clients thousands of dollars.

"It is not only in writing specifications that the engineer needs to express himself well. Very many projects are accepted or rejected on the report of the engineer. Only if he can express himself clearly, accurately and briefly can those he works for understand what his reports are about. Moreover, most great engineering works vitally affect everyone. Unless the engineer can tell the public in clear, plain language what his purposes are and how he plans to accomplish them, he has trouble ahead.

"Now let us touch on another field, seemingly remote from engineering—the appreciation of beauty. In a primitive community, people may be satisfied to have ugly structures around them if they only are strong enough. But as soon as the public develops taste and self respect it begins to demand that its useful things shall be beautiful as well. The engineer is forever changing the face of the earth, and if he has a sense of beauty he adds very much to his value. The more intelligent the people he works for, the more they will demand this quality in his work.

"Strange as it may seem, an engineer needs a knowledge of history and economics. Some years ago I directed a great engineering project where a knowledge of history affected the cost of the job to the extent of several million dollars. We were designing works to last for centuries, and the lives of thousands and perhaps hundreds of thousands of people depended upon their being always in working order. If we could depend upon a continuance of reasonably honest, intelligent government we could plan cheaper works which, however, would require perpetual careful supervision. If we should build such cheaper works, and if then the government should fall into incompetent hands, a catastrophe might result. What did history teach as to the probabilities? It taught us that we should spend the extra millions and make the works safe even with ignorant and inefficient management.

"An engineer should have a knowledge of economics. 'Will this project pay?' That is a question most often asked him. Unless the engineer understands some of the principles governing production and exchange, unless he can estimate in a general way the economic effects of his work, he will be an unreliable guide. Many great projects have been built in this country on the advice of engineers, only to develop into failures or too costly successes because the engineer was ignorant of economics.

"The engineer needs to understand social and industrial relations. Some years ago I was asked by some men having money to invest to recommend to them a great reclamation project in the south. I refused, saying I thought the project would not be feasible for many years. The soil was extremely fertile, the engineering conditions were favorable, and the project could, no doubt, be constructed. But I believed that the people who were counted on to settle on the reclaimed land would not accept the social and climatic conditions. The project was built, seemed at first a success, but ended in disastrous failure, because the settlers all left.

"I have spoken of engineering, because that is my field, but the same principles apply in law, medicine, architecture, business, and in most callings. There is an old saying about the intelligent, well informed man that 'all is grist that comes to his mill.' Such a man makes the most out of life.

"At Antioch College, at Yellow Springs, Ohio, we have organized college education with these facts in view. We believe that the best preparation for any calling is all-round education and all-round experience, supplemented by special training for that calling. Antioch students are preparing for business, engineering, finance, journalism, scientific research, home economics, education, and other callings. But nearly half their time at college classes is spent in getting a sound, general education in natural science, social science, English and literature and other subjects of universal value."

* * *

On Again and Off Again Without an Arc

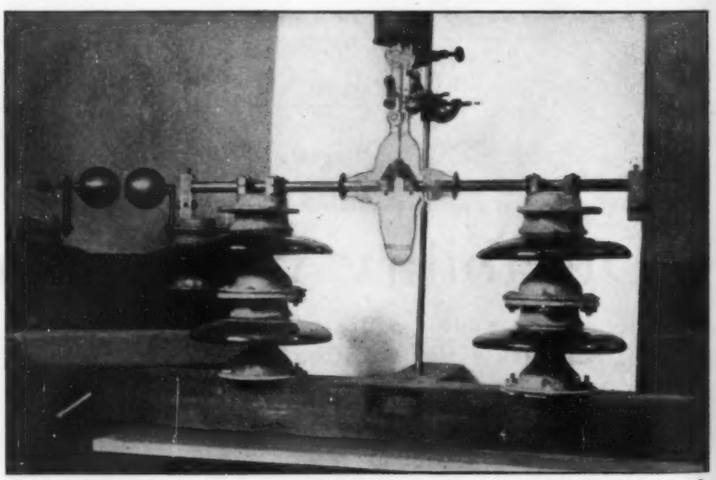
A PHOTOGRAPH of the first invention to be worked out and perfected in the million-volt laboratory of the California Institute of Technology at Pasadena, California, is reproduced in these columns. It is a vacuum switch, the product of the work of Prof. Royal W. Sorenson, aided in his experiments by Dr. Robert A. Millikan.

The invention is designed to take the place of costly and ponderous oil-immersion

Wide World Photo

Prof. Royal W. Sorenson, inventor of the vacuum switch

switches that have been used in large power plants to cut off heavy currents of electricity on short notice. The principle upon which it is based is the well-attested fact that electricity will not travel through a perfect vacuum. A terrific arc results when a high-tension current—say of 100,000 horsepower—is cut off in the open air. Some protective device is necessary. Heretofore, extremely large, expensive oil-immersion switches have been installed in all large power plants to quench these arcs in times of emergency. In the splendidly equipped laboratory of the Institute, Prof. Sorenson has been able to establish a virtual vacuum within a small glass bulb which, placed as shown, serves as a cut-off switch.

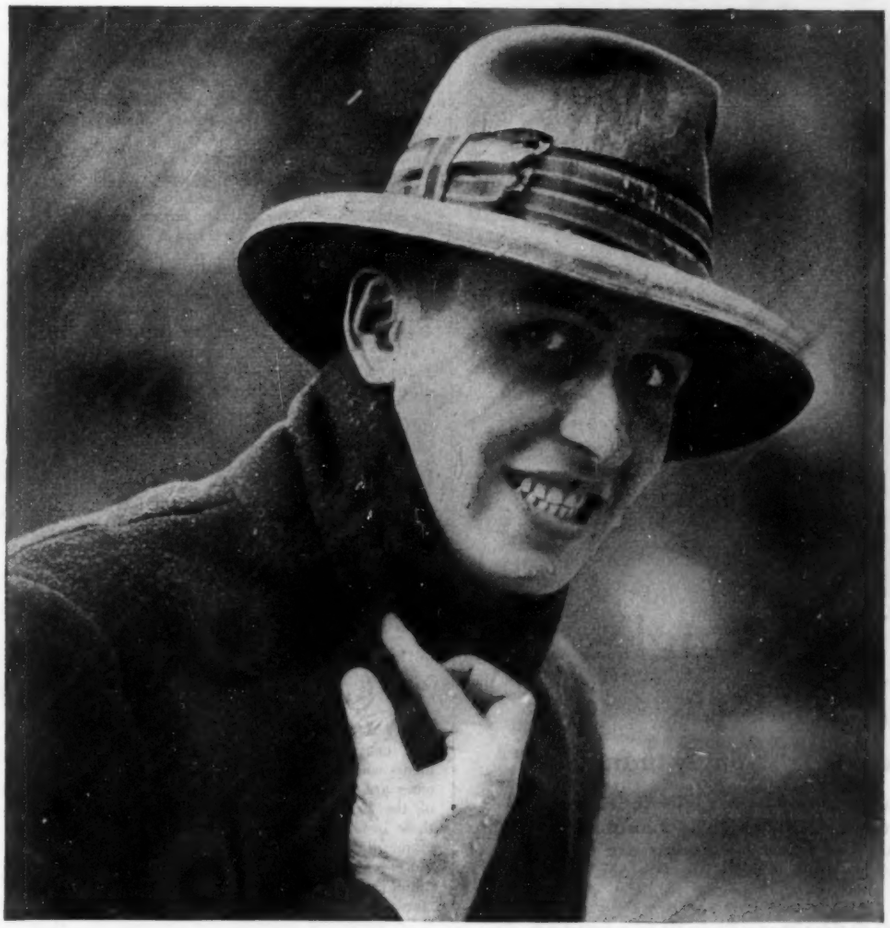


Professor Sorenson's new vacuum switch, containing only one billionth part of the original content of air. The near-vacuum prevents arcing

"We have fully established the theory, and all our tests have been successful," he explains. "We have handled a circuit up

(*Continued on page 454*)

WATCH YOUR THROAT!



Don't let it become serious!

AS you probably know, certain harmful bacteria are constantly present in the mouth and throat. And unless proper precautions are employed these disease germs may often get the upper hand and multiply more rapidly than nature can fight them off.

At such times your throat becomes irritated—Nature's way of telling you there is danger ahead.

Particularly at this time of year everyone should watch the throat very carefully. The ideal mouth and throat protection is the systematic use of Listerine, the safe antiseptic.

Its regular use by the entire family, as a mouth wash and gargle, is an easy way to be on the safe side.

Also, then you will be on the polite side in regard to that insidious condition, halitosis (unpleasant breath). — Lambert Pharmacal Company, St. Louis, U. S. A.

Risk a quarter!
Risk a quarter on our reputation. Buy a tube of Listerine Tooth Paste. Our reputation won't suffer.
LARGE TUBE—25 CENTS

LISTERINE

—the safe antiseptic

Plylock is a laminated product made from selected veneers of genuine Douglas Fir. It is not to be confused with ordinary commercial fir plywoods, for every piece is built to the most rigid standards. It is made in 3-ply, 5-ply and special thicknesses to meet individual needs.

From durable Douglas Firs comes Plylock

—"wood that's stronger than wood"

Douglas Firs of the Pacific Northwest, majestic in height and girth, are the material from which is manufactured genuine Plylock. Only the finest specimens are used—clear, sound timber, which makes possible Plylock's uniform high quality.

Many lines of industry are turning to Plylock as a solution for vexing construction and production problems. Its strength combined with lightness, its permanence and freedom from warping and splitting make it ideal for many uses.

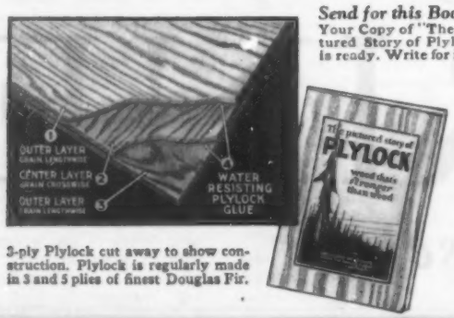
If you make automobile bodies or running boards, doors, shelves, cabinets, phonographs or radio sets, toys, desks or furniture, or any similar lines, write at once for a copy of "The Pictured Story of Plylock." Full size samples will gladly be supplied gratis for experimental and development work in your own plant, and our research department is at your service.

PORTLAND MANUFACTURING CO., PORTLAND, OREGON

Plywood makers for 27 years

PLYLOCK

"Wood that's *stronger* than wood"



3-ply Plylock cut away to show construction. Plylock is regularly made in 3 and 5 plies of finest Douglas Fir.

Send for this Book—Your Copy of "The Pictured Story of Plylock" is ready. Write for it.

to 1,000 amperes at 40,000 volts safely and without any difficulty whatsoever. Probably we could have used more had the power been obtainable. The next step will be to make the simple device commercially practicable."

When the new method was tried out recently in a California station, the vacuum switch-gap was left open only one inch. However, the entire current of 40,000 volts stopped instantly without so much as registering on the oscillograph record which is "tuned" to the thousandth part of a second in order to catch such disturbances.

It was Prof. Sorenson who conceived the idea of what he calls "a cascade hook-up" by which four of the hitherto largest transformers—each with a capacity of 250,000 volts—could be linked into one, giving the marvellous output of a million volts for the use of scientific research. Several such super-plants, using his hook-up, have been built in the east in the past few years.

A specially designed building was prepared at the Institute to house the four units now in use. Each may be operated independently or in a number of combinations that are tremendously interesting to experts. The transformers are of the core type, the cores being two-legged, with half the winding on each leg. They are, of course, of the indoor type, approximately ten feet in diameter by sixteen feet high over the lead top. The weight of each, when filled with oil, is 45,000 pounds.

Intricate, elaborate, and as complete as human ingenuity has yet devised, is all the equipment with which these eager scientists are working, seeking to evolve new things to benefit mankind. The vacuum switch merely happens to be first.

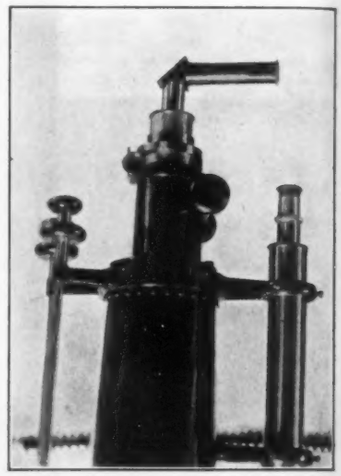
* * *

A Simple Spectroscope

A GREAT many of the scientific instruments which are used by the modern astronomer are designed to help him in the study of the light emitted by stars, and among these instruments the spectroscope is one of extraordinary importance. With the aid of the spectroscope he has been able to determine the stage of development of certain stars. He has also been able to measure their speed and ascertain the direction of their travel through the boundless spaces of the universe. More than that, he has been able, by using the spectroscope in conjunction with the sensitive photographic plate, to print the spectra of stars, and thus to establish permanent records of great value to himself and to the astronomers of coming generations.

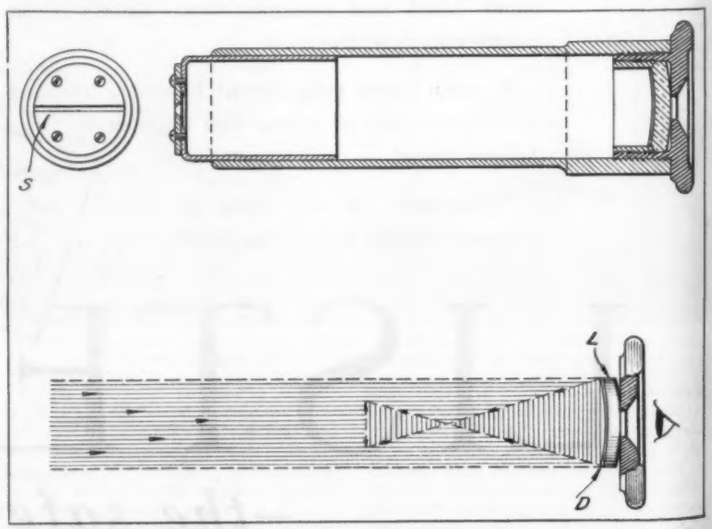
In the broadest sense, the spectroscope is used to analyze light. White light, as it comes from the sun, for example, is composed of light of all colors, each having its characteristic wavelength; violet has the shortest and red the longest waves. The different colors are separated by the spectroscope which shows them in a continuous band from violet to red. This band of colors is called the spectrum. The rainbow, for example, represents such a phenomenon. In it the drops of rain bring about a separation of the sun's light. The finer and more accurate the mechanism of a spectroscope the more details will be revealed in the spectrum and the finer and more distinct will be the different nuances in each color.

The type of spectroscope the astronomer uses in his exacting scientific investigations is an instrument of great sensitiveness, intricate in its mechanism and requiring the trained mind and the skilled hand of an expert to operate it. For the amateur who likes to study spectroscopic phenomena this kind of instrument is, as a rule, too cumbersome to manipulate and too expensive to acquire. The little instrument pictured here, however, is a simplified type of spectroscope. It is easy to handle and can be made by anyone having ordinary skill in things mechanical. Its description was submitted by Ernst Keil, of the Department of Zoology at Denison University.



A refracting telescope equipped with a small spectroscope. The right-angle prism at the elbow in the tube was added for comfort in observing

The elements of this simple instrument are all contained in one tube about four inches long and one and one-quarter inches in diameter. It consists of three parts, a tube which carries at one end a narrow slit and at the other end the eyepiece. This eyepiece is the most interesting as well as the most important part of the whole instrument. It contains the lens and a transmis-



Above: **Longitudinal and cross sections of a home-made spectroscope. *S* is the slit.** ***Lower:*** **The optics of the spectroscope shown above. *L* is the lens. *D* is the diffraction grating applied to its curved face. The plane on which the spectrum is formed is indicated by the vertical arrows**

sion grating. The lens is an ordinary, plano-concave spectacle glass given a circular form, with a focal length of about three inches. With a little care it can easily be trimmed to the desired form on a grindstone or fine emery wheel. The transmission grating is a piece of transparent replica made from a diffraction grating; it is placed on the concave side of the spectacle glass, pointing toward the slit. The replica grating, which may be purchased from manufacturers of scientific apparatus for a few dollars, is prepared in the following manner: the replica proper, that is the thin celluloid film which contains the grooves, is as a rule mounted on a piece of plate glass. This film is carefully peeled off the glass and a piece the size of the lens is cut out and placed on the concave side of the lens.

The light enters through the narrow slit, striking the grating at the other end of the tube, thus producing a spectrum inside the tube. This spectrum may readily be observed through the opening in the eyepiece.

This instrument lays no claim to the accuracy of its more intricate brethren, nor will it cover so wide a range of work, nevertheless it may very successfully be employed for spectral-analysis in its simplest form. If care is taken to select a replica with a powerful first order, a comparatively large and brilliant spectrum will be obtained with many of the brighter spectral lines distinctly visible.

There are several ways in which this spectroscope may be used. One may hold it in the hand and view directly the source of light to be analyzed, or it may be placed in the ocular end of an astronomical telescope.

In the latter case the performance is as follows: the telescope is focused sharply on a star, then the eyepiece is carefully withdrawn and in its place the spectroscope is inserted. In the case of some of the brightest stars and under favorable atmospheric conditions very interesting results may be observed.

We belive Dr. Anderson of the Mt. Wilson Solar Observatory, Pasadena, California, was the first to suggest this type of spectroscope.

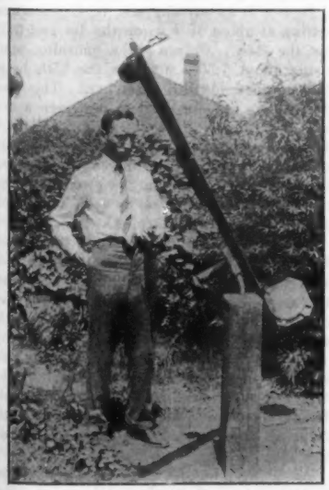
[A small, home-made spectroscope suitable for use with 3¼ x 4¼ camera plates, was described in the March, 1926, issue of *Popular Astronomy*, (Northfield, Minnesota) —Editor.]

* * *

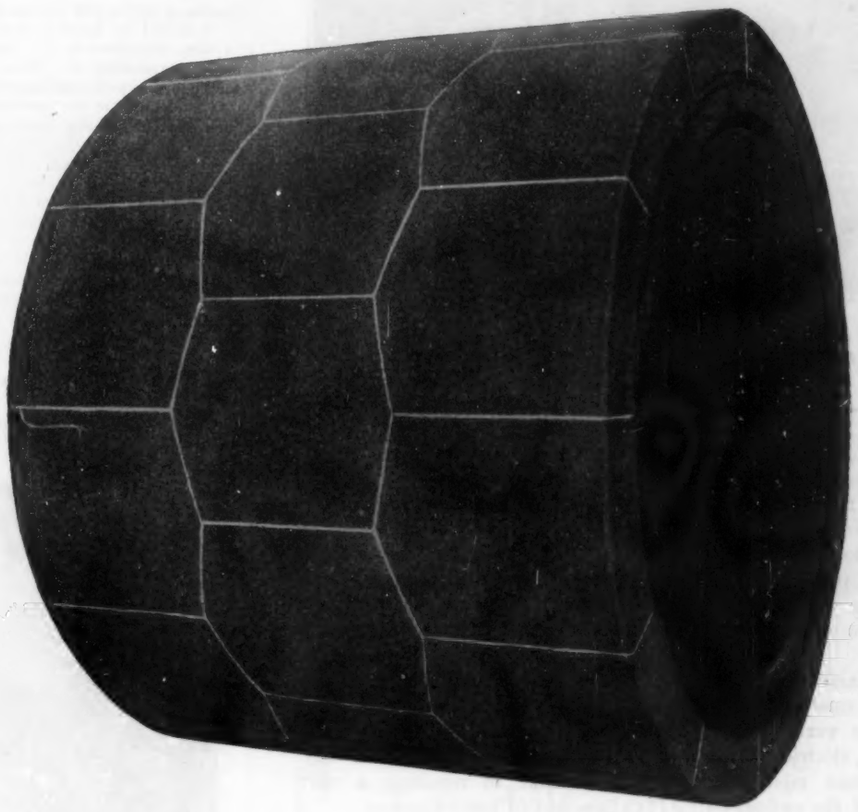
Temporary Mounting for Telescope Mirror

ELEGANT details and fine machine work may or may not improve the optical efficiency of a reflecting telescope. Mr. Stanley Bentley of 973 Terrace Fifty, Los Angeles, California, has demonstrated that a useful instrument may be made of simple parts, provided the optical elements are first class. Mr. Bentley sends us the following description of his telescope, a photograph of which is reproduced in these columns:

"The mirror is eight inches in diameter,



Mr. Bentley and his wooden telescope mounting



And now wood pulp is ground by a man-made abrasive

The manufactured grinding wheel has taken its place in the pulp industry. Groundwood pulp, uniform in quality, is now being produced successfully by a Norton Pulp Stone.

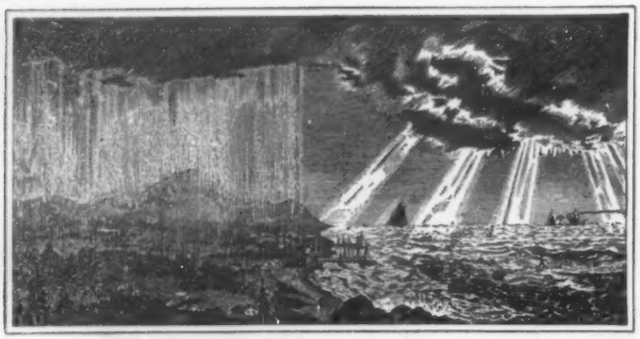
The Norton Pulp Stone replaces the quarried sandstone wheel used in pulp mills since the beginning of newsprint pulp, just as the man-made wheel has replaced the old-fashioned grindstone in the manufacture of cutlery and hundreds of other products. Thus the abrasive wheel trademarked "Alundum" or "Crystolon" carries on through industry after industry playing its vital part in countless numbers of grinding and machining operations. Today, there is hardly an industry in the world which, directly or indirectly, does not depend upon modern abrasives and grinding machines.

NORTON COMPANY, WORCESTER, MASSACHUSETTS

NORTON

Grinding Wheels
Grinding Machines

Refractories-Floor and Stair Tiles



Rain and Telephone Calls

THE annual rain fall in the United States would weigh over three and one-half trillions of tons.

This vast weight is drawn up to the clouds by the unseen but effective power of the sun; representing energy equivalent to three hundred billion horsepower.

The annual telephone conversations total over twenty-five billion a year. As silently as sunlight, electricity, mastered by the human mind, carries the voices of the nation.

There must be the man-power of 300,000 individuals to build, maintain and operate the telephone system.

There must be the money-power of over seven hundred million dollars a year to pay for operating the plant, in addition to three billion dollars invested in the plant.

The rain sustains life; the telephone furnishes swift communication for the nation, and they are alike in requiring a vast amount of unseen energy.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

BELL SYSTEM

IN ITS SEMI-CENTENNIAL YEAR THE BELL SYSTEM LOOKS FORWARD TO CONTINUED PROGRESS IN TELEPHONE COMMUNICATION

one inch thick and the tool was half-inch glass. The focal length is 80 inches. Not having an oil lamp for testing I used a frosted Mazda electric lamp in a tin can having a needle hole in one side.

"I started the figuring of my mirror with a deep depression in the center and three zones surrounding it. These later worked out into a hyperboloid, but this succumbed at last, thanks to the excellent instructions in your book. I now have a mirror which, I think, deserves a real mounting and I intend to make this soon. The total cost of the instrument was $12.50."

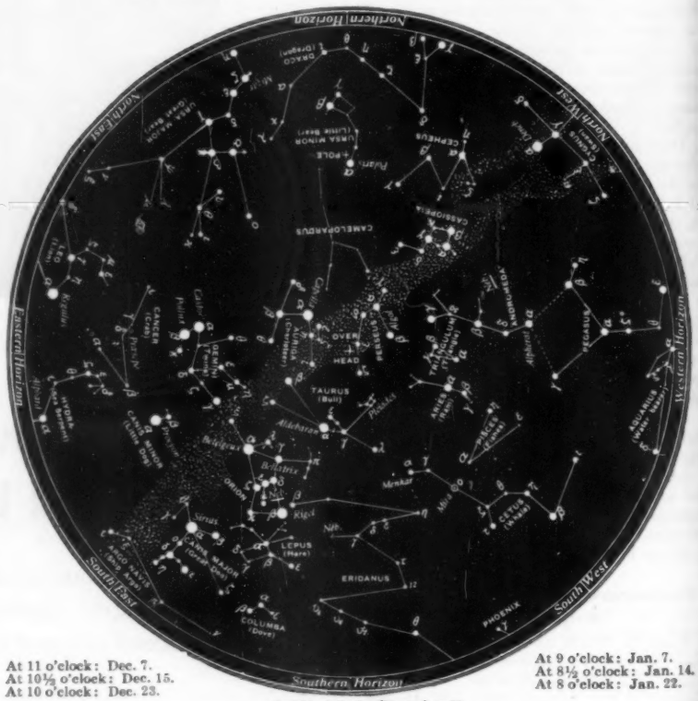
Mr. Bentley writes that before attempting to make an eight-inch mirror, he made a simple four-inch mirror of 5/16th-inch plate glass. This, with a simple mounting, cost $5.92. The experience gained on this preliminary job proved invaluable on the large mirror.

New Method of Case-Hardening Alloy Steels

A NEW method of producing a very hard steel skin on chromium, aluminum and manganese steels has been worked out by scientists of the Krupp works at Essen, Germany. The metal to be so treated is provided with an atmosphere of nascent nitrogen at a temperature under 1,100 degrees, Fahrenheit. Allowed to cool slowly, the steel actually absorbs some of the nitrogen, which results in a measurable increase in volume of the steel. It is claimed that the process, which can be employed with the ordinary quenching methods, produces steel which is especially suitable for machine parts working at high temperature where even superior alloy steels frequently prove to be inadequate for the work at hand.—*Science Service.*

The Heavens in December

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Dec. 7.
At 10½ o'clock: Dec. 15.
At 10 o'clock: Dec. 23.

At 9 o'clock: Jan. 7.
At 8½ o'clock: Jan. 14.
At 8 o'clock: Jan. 22.

At 9½ o'clock: December 30.

NIGHT SKY: DECEMBER AND JANUARY

The Heavens

ON our star map this month Castor is conspicuous high in the east along with its neighbor Pollux. Far above, and even brighter, is Capella, while Procyon is to the right and a little below. Sirius is well up in the southeast. Betelgeuze and Rigil, with the other stars of Orion, are above, and higher is Aldebaran. Mars, a little to the westward, outshines them all but Sirius. The southwestern sky is very dull but Pegasus and Andromeda enliven the west, and Perseus is above in the zenith. Cassiopeia is high in the northeast, and Cygnus is setting below. Ursa Minor and Draco are low in the north, and Ursa Major in the northeast. Leo and Hydra, just rising, complete our list of constellations.

The Planets

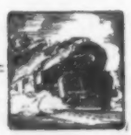
Mercury is a morning star this month and best visible about the 14th, when he is apparently farthest from the sun and rises at 5:30 A.M. Venus is just coming out as a morning star; but as she sets only half an hour after the sun she can be seen only with great difficulty. Mars, although well past opposition, still dominates the evening sky. He is in the western part of the skies and is due south at 8:30 P.M. in the middle of the month, remaining in sight until after three in the morning. By the end of the year he is almost twice as far off as he was in October, but he is still a brilliant object, and well repays telescopic observation.

Jupiter is an evening star in Capricornus, setting at about 10 P.M. on the 1st and 8:30 on the 31st. Saturn is a morning star, rising about 5:30 A.M. On the 15th he is in conjunction with Mercury. The two planets are but one-third of a degree apart, and should be conspicuous just before dawn. Uranus is in Pisces, and comes into quadrature east of the sun, on the 18th, so that he is observable in the evening. Neptune is in Leo, and can be seen (telescopically) in the early morning.

The moon is new at 1 A.M. on the 5th, in her first quarter at 2 A.M. on the 12th, full at 1 A.M. on the 19th, and in her last quarter at midnight on the 26th as this day closes. She is nearest the earth on the 12th, and farthest off on the 26th.

During the month she is in conjunction with Mercury on the 3rd, Saturn on the 4th, Venus on the 5th, Jupiter on the 10th, Uranus on the 12th, Mars on the 15th, Neptune on the 23rd and Saturn again on the 31st.

At 10 A.M. on the 22nd the sun reaches its greatest southern declination and "winter commences."



Going to Travel?

Then by all means refer to the travel section of Harpers Magazine—Every month you will find many alluring suggestions and the announcements of a large number of Tourists Agencies, Railroads, Steamship Lines, Resorts and Hotels.

SAILING DATES IN EVERY ISSUE

For the convenience of our readers we will publish each month the sailing dates for Europe and other countries together with the dates of special tours and cruises.

Feel perfectly free to write us—Our Travel Bureau will gladly furnish any information desired.

Harpers MAGAZINE
49 East 33rd Street, New York, N. Y.

PAT The German-American Co-Operative Working Association for the Exchange of Patents seeks collaborators who would endeavor to effect the introduction of approved German inventions. Gewerberat Hartig, Brieg bei Breslau, Germany.

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BRADLEY INSTITUTE
The greatest school for watchmakers in the world. Address Horological Dept. H, Bradley Polytechnic Inst., Peoria, Ill., for our latest catalogue.

Patent For Sale

REFLECTING SIGNAL FOR ROADWAYS. Of great value to cities and towns alike and a boon to motorists. This inexpensive device is operated by the light rays received from the headlights of approaching vehicles, and makes highways plainer in night fog. U. S. Patent No. 1,600,887. Address William M. Rimbrough, 1025 Eighteenth Street, Bakersfield, Calif.

Factory For Sale or Lease

$10,000 buys 20,000 sq. ft. or $25,000 buys 75,000 sq. ft. one-story brick building just rebuilt; 30 ft. high; in heavy industrial zone of Newark; ocean transportation direct to 300 ft. dock on Passaic River; 1500 ft. railroad siding; 2-15 ton cranes; 4 acres land. Rent 30 cents per sq. ft.

GROSS & GROSS
20 Clinton Street Newark, New Jersey

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Wide World

Captain R. H. Ranger (left) and his improved radio-picture apparatus designed for sending illustrations between New York and London

Sees Big Future for Radio Business

RESEARCH work in radio will naturally go on indefinitely according to George A. Scoville, Chairman of the Merchandising Committee of the American Manufacturers of Electrical Supplies.

"Refinements such as we find making their appearance in the automobile field will, no doubt, follow in radio. But it is safe to say that a few of the better receivers now on the market can be looked upon by the purchaser as coming fairly close to a permanent investment," said Mr. Scoville.

"It is the opinion of radio officials that out of the approximately 4,000,000 sets in use in the United States, at least half of them are so far behind modern developments that there will be evident a great desire on the part of the public to replace the old sets with new. This means a future, potential market of those already acquainted with radio of about 2,000,000 receivers. In addition there will be at least an equal number of people out of the 12,000,000 who own phonographs, who will purchase radio sets this year. From an estimated volume of 500,000,000 dollars in 1926, it is believed that it is conservative to state that 1927 will show the industry has reached a figure exceeding 650,000,000 dollars.

German Radio

RADIO broadcasting in the United States is two years ahead of European development, according to Gunter Doberzinsky, a director of the Central Germany Broadcasting station at Leipzig, who recently visited in this country.

"I have examined many radio receivers and visited factories and broadcasting stations and am amazed at the progress you have made," said Mr. Doberzinsky. "Unquestionably Europe has much to learn from America in radio. The American sets tend toward greater simplicity and are controlled by a single dial. Your sets can be tuned by a finger, while in Germany we must tune with both hands. And in Germany one must pay equivalent to 250 dollars for a good set.

"It is possible to receive in Germany with one tube, or even a crystal set, with fairly good results. The stations are nearby and there is little interference. A crystal set can be bought for $1.50 and a one-tube set for six dollars, which will enable you to listen in on a single station. Those who wish to hear distant stations must have good sets, but the demand has been limited. That is why high-grade sets have not developed as rapidly in Europe as in the United States. Europe still uses the old-fashioned horn for a loudspeaker. The modern cone loudspeaker is practically unknown.

"American and German stations are financed very differently," said Mr. Doberzinsky. "Our stations have plenty of money at the present time but lack the element of competition you have in the United States. In Germany, 51 percent of the stock of the broadcasting stations is owned by the government, and 49 percent by private stockholders. Every owner of a receiving set pays 50 cents a month for the privilege of listening in. Since there are more than 1,000,000 receiving sets in Germany today the income is obviously large. Of the total sum thus collected 40 percent is devoted to technical work and building of stations and 60 percent is devoted to operating expenses. There is but one broadcasting station in each of the large German cities, so each is well supplied with money, and in many cases the stations support fine orchestras and large opera companies. However, we lack the competition that is present in the United States and competition is necessary to develop new ideas and a high grade of entertainment in general.

"One of the newest radio developments in Germany is the railroad radiophone. It is possible to pick up a telephone on a train and be connected with any telephone in any part of Germany by radio. The traveler enters a telephone booth in the dining car and asks for a number exactly as he would make a local call in New York. The connection is established very quickly and one can talk under these conditions with perfect satisfaction. A train passenger can telephone across Germany for about a dollar."

Navy Installs 80-Kilowatt Station

A RADIO transmitter rated with an output of 80,000 watts, said to be the largest vacu-

Eveready's exclusive Layerbilt construction *makes this the most economical of "B" batteries*

IMPROVEMENT on top of improvement has been the history of Eveready Radio Batteries. Here, in the radically different Eveready Layerbilt, is the "B" battery which tops them all. The ability of this battery to give you unrivaled service and economy is due to its unique internal design. Instead of the usual assembly of round cells, it is built of *flat* layers of current-producing materials pressed firmly together. This construction makes use of the spaces now wasted between the round-type cells and avoids the usual soldered wire connections. Eveready Layerbilt is every inch a battery. This exclusive Eveready Battery development packs more active chemicals in a given space and enables them to produce more current and give longer life. This HEAVY-DUTY EVEREADY LAYERBILT BATTERY gives twice the service of the smaller Light-Duty batteries and greatly reduces your "B" battery operating cost.

Use Eveready Layerbilts on any set, and get not only this extra service, but also the greatest "B" power operating economy—the utmost in "B" power dependability—D. C. (direct current) in its purest form, which is so necessary for pure tone quality.

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NATIONAL CARBON COMPANY, Inc.
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Tuesday night means Eveready Hour—9 P. M., Eastern Standard Time, through the following stations:

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WSAI—*Cincinnati*
WTAM—*Cleveland*
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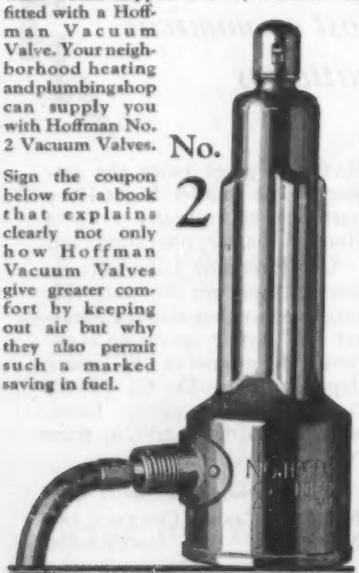
Have continuous heating comfort and save ⅓ of your fuel

YOU will be amazed at the change Hoffman No. 2 Vacuum Valves make in a one-pipe steam heating plant. You get heat in radiators as soon as drafts are turned on. Radiators stay hot hours after fires are banked. These valves revolutionize steam heat because they keep out the Heat Thief—AIR. And in addition to providing this marked improvement in heating comfort, they save ⅓ of your fuel.

Test a single valve

MAKE a test on the radiator that has been the hardest to heat. Change the venting valve to a Hoffman No. 2 Vacuum Valve. Notice how quickly this radiator heats. Hours after fires are banked at night, observe that it is still warm. Then consider what would happen if every radiator was fitted with a Hoffman Vacuum Valve. Your neighborhood heating and plumbing shop can supply you with Hoffman No. 2 Vacuum Valves.



Sign the coupon below for a book that explains clearly not only how Hoffman Vacuum Valves give greater comfort by keeping out air but why they also permit such a marked saving in fuel.

HOFFMAN VACUUM VALVES

LOCK OUT THE HEAT THIEF - AIR

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The house I occupy has steam heat. Send me the booklet, "Locking the Door Against the Heat Thief."

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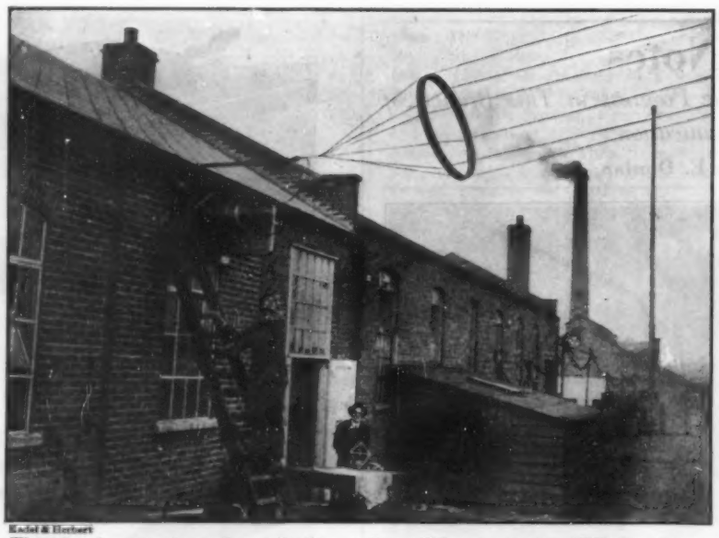

Kadel & Herbert

This six-wire cage is used as a lead-in at the well known station 5XX, located at Chelmsford, England. Note the size of the lead-in insulator

um-tube installation in the world, has been put into operation at the naval radio station at San Diego, California, according to an announcement by the Radio Division, Bureau of Steam Engineering, Navy Department. The equipment was not designed for telephone use, but will be used for radio-telegraph communication. Messages may be sent at the rate of 100 words a minute.

It was pointed out that within a few years the navy arc transmitters will probably be replaced by vacuum-tube transmitters.

The transmitter at San Diego is about four times as powerful as any other vacuum-tube set used by the Federal Government, according to the Navy's radio engineers. It is capable of radiating about 80 times as much electric energy as the ordinary radio-phone broadcasting station using 1,000 watts. With this modern installation the Navy Department will be able to communicate directly with NSS, Annapolis, Maryland, with the Hawaiian Islands, with Japan and with the battle fleet, no matter where it is cruising on the Pacific.

Naval engineers say that the new station will in no way interfere with broadcast listeners.

Radio Statistics

THE statistical department of station WEAF recently announced the results of a two-year survey made of broadcasting in the United States. From the data collected, it was revealed that of the 1,424 broadcasting stations licensed by the Government since November, 1920, 878, or 62 percent, have ceased to function. The two principal reasons for the discontinuance of broadcasting are inability to finance, 45 percent, and service unsatisfactory as compared with the larger competing stations, 17 percent.

The survey indicated that the potential audience of WEAF and a chain of 16 other stations is more than 15,000,000. However, discounting the potential audience by 75 percent, there remain 3,750,000.

A questionnaire was distributed to WEAF's auditors and more than 64 percent of those addressed replied. The answers indicated that the average number of listeners per set is five, and that 62 percent of the radio set owners own their homes. Pleasure cars are owned by 46 percent; pianos by 50 percent; phonographs by 74 percent, and about 81 percent have electricity for lighting their homes.

The coverage of WEAF's network as compared to the continental United States shows that 59.5 percent of the receiving sets in the country, and 50.1 percent of the total population is in range of the New York programs radiated by the chain of transmitters. Seventy-five percent of the people listening in live in cities and approximately 29 percent live on farms, according to the survey. It is estimated that WEAF's net spreads radio entertainment over 24.6 percent of the farms in the United States.

Power-Supply Units

RADIO stores are now handling a variety of "B" eliminators and "A-B-C" power-supply units, which supply the detector plate voltage, the proper amplifier plate voltage, 135 volts for power amplifiers and in the case of the "A-B-C" units, voltage for lighting the tube filaments and for the grid bias.

The "A-B-C" units generally are equipped with a trickle charger using a rectifying

Herbert Photos

A radio loudspeaker. This reproducer resembles an open book. The music and voice come from the pages of the "book"

ASK . . . ANY . . . RADIO . . . ENGINEER

With the "Trouble-Shooters" of the North Atlantic

ICE-BERGS—towering, ponderous, *deadly* mountains of ice drift southward from the ice fields of the Arctic into the traffic lane of trans-Atlantic steamers.

Locating and destroying them is the perilous and never-ending duty of the United States Coast Guard Cutters.

Shell fire and high explosives, however, often fail to blow the bergs from the sea, and warnings are then broadcasted by radio to every ship whose course lies through the danger zone.

Smooth power, unfailing dependability over long periods and under all conditions of service are qualities demanded in the radio batteries used in this dangerous naval service.

The fact that Burgess Batteries meet those requirements recommends them to you for your own receiving set.

Ask Any Radio Engineer

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BURGESS RADIO BATTERIES

SOME OF THE PROFIT SHOULD BE YOURS!

Someone is going to make plenty of money in the coming months charging batteries. Some of it should be yours. Order a

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today. It is a slave for work, needs no watching, and is economical to operate.

Liberal Discount to Jobber. **$50.00**

THE ADAMS & BARRE CO.
Fifth and King Ave. Columbus, Ohio

Herbert Photos

An interesting 40-meter transmitter, with power of 60 watts and equipped with European type tubes. Walter C. von Brandt is seen holding one of the set's tiny tubes and a standard 250-watt tube for comparison

tube which keeps the storage "A" battery fully charged at all times. A number of these instruments are provided with an automatic relay which functions when the "A" filament switch is turned "on." When the switch is snapped to the "off" position the relay automatically disconnects all power-supply units from the receiver and places the storage battery on charge. These automatic relay switches are also marketed separately so that radio set owners can install them on their present equipment.

The operation of the power-supply unit is explained as follows: Current flows through the trickle-charger transformer supplying current for the filament of the rectifier tube and at the same time current for the plate of the tube. There is then available at the "A" battery leads a direct current of about .6 ampere at a potential of 6 volts.

When the storage "A" battery is connected to the leads, it is placed on charge. (When going away for an extended time, turn off the 110-volt supply; that is, disconnect the plug from the light socket.)

As soon as the owner desires to use the radio the filament switch is turned to the "on" position and a small relay operates, which automatically disconnects the "A" battery from the charger, shuts off the rectifier tube and lights the filaments of the UX-213, full-wave rectifier, besides furnishing the tube with plate voltage. When this occurs, there is from 90 to 135 volts on tap for the detector and amplifiers. "C" battery voltage is also provided at this time.

When the operator is through using the set he turns the filament switch to the "off" position, disconnecting the UX-213. The rectifier tube then is lighted and the "A" battery is again put on charge.

No change in the wiring of the receiver is necessary when a current-supply device is employed. The connections are made to binding posts in the same manner that batteries are attached to the set.

Fifteen Licenses for Research

FIFTEEN licenses to operate radio transmitters have been issued to the General Electric Company by the Department of Commerce so that the research engineers of that company may make a comprehensive inquiry into the mysteries of the ether.

Rarely are more than six transmitters on the air at the same time on the radio reservation at South Schenectady. The wavelengths are so far apart that they do not encroach upon each other, and furthermore, all of the transmitters are controlled by crystal quartz which holds them on the exact wavelength, thus preventing interference.

The licenses are for the following stations and wavelengths: 2XAW, 3 to 20 meters; 2XO, 2XAF, and 2XAD, 10 to 50

Herbert Photos

A loop antenna direction finder. Captain W. G. Hamilton of the *S.S. Macom*, the flagship of the Department of Plant and Structures' fleet in New York Harbor, often finds the radio compass useful when fog envelopes the bay

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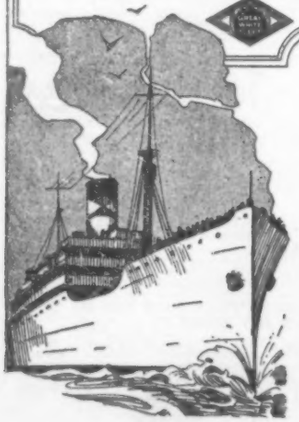

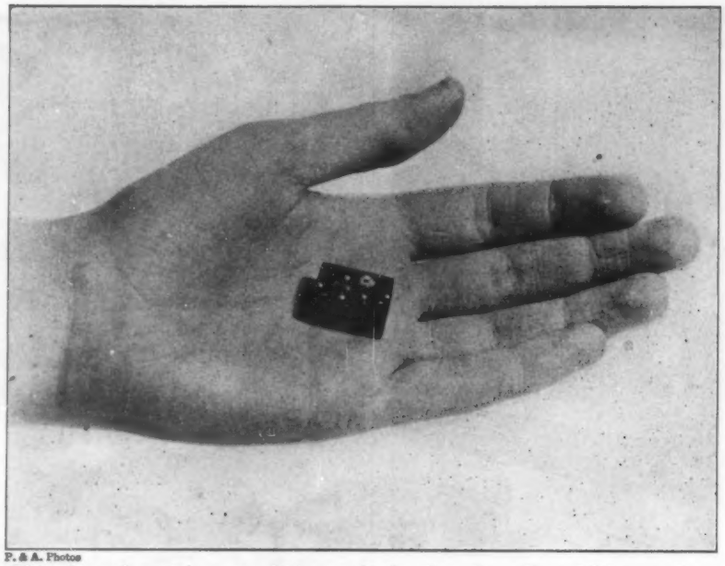

F. & A. Photos

This plywood receiving set, which was displayed at the radio exhibition at London's famous Olympia, weighs only as much as a wedding ring. It easily fits into the palm of the hand. Excellent reception is obtained from local stations

meters; 2XH, 2XK and 2XAC, 50 to 150 meters; 2XAK and 2XAZ, 100 to 200 meters; 2XAG (50 kilowatts), 380 meters; 2XAH, 1,000 to 4,000 meters; 2XI, general experimental license; 2XAM, 110 meters; 2XAE, 110 meters. The fifteenth license is for broadcasting purposes and it is best known to the broadcast listeners. It is WGY, licensed to operate on 379.5 meters.

Station 2XAF is now being used on 32.79 meters for relay to Europe, South Africa and Australia.

702,000 Receivers in New York

AN analysis made by the management of station WEAF is the basis of an estimate that in the territories covered by stations in the cities listed here, radio sets are distributed as follows: New York, 702,000; Boston, 380,000; Philadelphia, 265,000; Washington, 166,000; Buffalo, 125,000; Pittsburgh, 208,000; Cleveland, 172,000; Detroit, 224,000; Cincinnati, 187,000; Chicago, 354,000; St. Louis, 146,000; Minneapolis, 73,000; and Davenport, 88,000, making a total of 3,090,000. Based upon these figures it is believed that there are approximately 5,200,000 receiving sets on the United States.

Volume of Mail

MAIL from radio fans cleared through station WEAF's network, not including communications sent direct to the sponsors of programs, shows the following monthly average for each client during 1925; January, 2,343; February, 3,418; March, 2,894; April, 2,095; May, 1,315; June, 570; July, 599; August, 434; September, 630; October, 1,655; November, 1,236; December, 1,907. The heaviest mail is received from October to May, inclusive.

Clam-Shaped Loudspeakers

SEVERAL manufacturers of the cone-type loudspeaker are building the instruments in the shape of a clam shell instead of a disk. They place the apex at the lower part of the face instead of in the center, as in the case of disk loudspeakers. The designers contend that the new shape gives all frequencies a better chance to reproduce truly. The fronts of many of the new cone loudspeakers are decorated with landscape paintings, sailing ships and various other designs.

Rechargeable "B" Batteries

RECHARGEABLE dry-cell "B" batteries have now been placed on the market. It is contended that this type of battery has an original life as long as the ordinary "B" battery, but can be recharged six or eight times at the cost of approximately 1½ cents for each charge. These batteries can be charged on alternating current from any standard "B" battery charger or chemical rectifier. Where direct current is available a rectifier is not required.

Trickle Chargers

TRICKLE chargers are much in evidence at the radio shows this year. One manufacturer said that he sold more than 200,000 of these devices last season and that the demand is greater this year. The trickle charger is a device, which, once connected to the "A" storage battery, instead of operating intermittently at a high rate, functions continuously at a low rate, automatically keeping the battery fully charged. In reality, it converts the "A" storage battery into a power unit. Trickle chargers are noiseless in operation, and the current consumption is estimated to be approximately half a cent per hour of reception.

Majority of Stations Located Here

COMMENTING upon the growth of the radio industry as reflected by exports, Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce of the United States, pointed out that the majority of the world's broadcasting stations are located in this country and that the peoples speaking the English language are leading all others in the development of radio.

"Exports of radio equipment from the United States during the last five years have been valued in round numbers at 1,000,000, 3,000,000, 3,500,000, 6,000,000 and 10,000,000 dollars for the respective years," said Dr. Klein. "Reports from all parts of the world give constantly increasing estimates of the number of receiving sets in operation and new broadcasting stations are opening every month. Steadily the legal barriers to radio development all over the world are being withdrawn and new countries are entering the field.

"The United States has more than three-fifths of the world's stations. In the number of sets per 1,000 population the United States leads with 48.3 sets, followed in order by the United Kingdom with 35.6, Sweden with 30.3 and the Union of South Africa with 26.7."

Tube Reactivators

THERE are several vacuum-tube reactivators on the market this season, prompted by the fact that detectors and amplifiers gradually lose their efficiency because the active material on the filaments is gradually consumed. Manufacturers of these devices say that nine out of ten tubes ready for dis-

(*Continued on page 462*)

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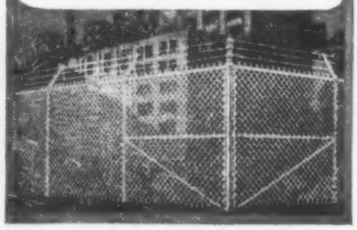

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card can be made to give many months of service by the process of reactivation.

The system is explained as follows: As the filament emission of electrons becomes less and less, the tube's ability to detect and amplify diminishes and the quality of reception falls off in proportion. New tubes should possess high filament emission, but this constantly decreases according to the amount of use or abuse to which they are subjected. In the Radiotron type of tube, the filament is of tungsten coated and combined with thorium. The filament is active only when there is a layer of thorium on the surface. The condition of the thorium coat governs the amount of filament emission.

Operating a receiver at too high a filament voltage quickly destroys the coating. The result is rapid deterioration of the tube; and, even at normal voltage, the filament's efficiency gradually decreases through continuous use.

It is pointed out that a thorium-coated filament tube should not be discarded or considered "dead" as long as the tube lights, simply because it fails to give the required results. Inside each filament there is a considerable amount of thorium and by applying the reactivating process, this material can be attracted to the surface of the filament, restoring the efficiency of the tube.

Compass Stations Kept Busy

RADIO compass stations along the American coast are becoming more and more important to navigation. During the period of one month, the navy compass stations furnished 19,952 bearings, of which 1,989 were for naval and 17,963 were for merchant ships. Cape Hatteras is generally the busiest station.

Railroad Radio

ENGINEERS working on the development of radio apparatus for trains report that they have a number of obstacles with which to contend. Bad reception spots are noticed when the train is in the vicinity of steel bridges. Tunnels also cause trouble. There is a perceptible roar in the loudspeakers while the train is in motion, but most of this disturbance has been eliminated by mounting the radio set on a rubber base to prevent mechanical vibrations from creating microphonic noises in the radio circuit.

The American Railway Association is urging its members to encourage and cooperate with manufacturers in developing simple and reliable radiophone apparatus for use in practical road service to enable men at both ends of long freight trains to maintain constant communication.

Why WGY Fades

WHY do the radio programs of WGY, Schenectady, wax and wane in the ether around New York? When asked to account for the fading, Harry Sadenwater, engineer in charge of the technical operations of the station, said, "I am about convinced that the Hudson River is responsible for the swinging signals. It seems to me that the waves travel more easily along the water and perhaps faster than over the land. The differences in the speed of the waves over the land and water, and possibly an interaction between the two may cause the fading."

The "N" Circuit

AN outstanding feature of the National Radio Exhibition held at Olympia, England, was the "N" circuit invented by Sir Oliver Lodge. It is said to represent the last word in simplicity. There is one tuning condenser and a filament control. Once these are adjusted an ordinary snap switch turns the receiver on or off. The set is designed not to radiate.

British Favor Crystal Sets

THERE are 1,800,000 radio set owners in England, according to the number of receiving licenses that have been issued. There are 20 broadcasting stations in the British Isles and 66 percent of the listeners use crystal-detector sets. It is reported that the most powerful station at Daventry can be heard 200 miles away on a crystal set.

Powerful Generators

THE large motor generator units which supply the current to light the filaments of the transmitting tubes of station WJZ, Bound Brook, New Jersey, deliver an output sufficient to light the tubes of all the receiving sets in New York City simultaneously, according to engineers of the station.

A Radio Voice for Uruguay

A NEW one-kilowatt transmitter, which has been ordered for installation at Montevideo, will serve as the official broadcasting station of the Uruguayan Government.

Herbert Photos

Japanese ladies in a Tokyo garden enjoying a radio program through the medium of crystal sets which are concealed in the handle of each parasol. The metal frame of the parasol serves as an antenna

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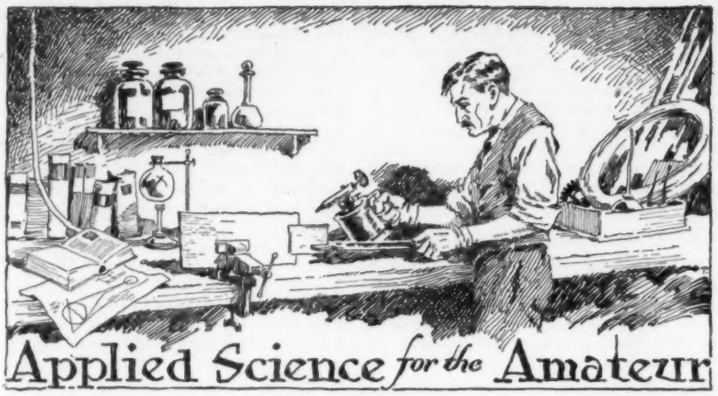

Applied Science for the Amateur

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Conducted by A. P. Peck

With this issue, we introduce a new department to our readers. In it, we want to present practical hints and kinks, formulas and processes and ways of doing things that are new, unusual or of particular value. To make this department of the greatest value to all, we invite our readers to contribute. Read the items in the columns below and then try to help your fellow readers by sending in some material that you think will be of general interest. We will pay for all articles that are accepted. Rejected items will be returned promptly when stamps are enclosed. The success of this department depends on you. Let us know what you think of it and be sure to do your part by contributing. If you can suggest any way in which these columns can be improved, do not hesitate to do so

For the Amateur Photographer

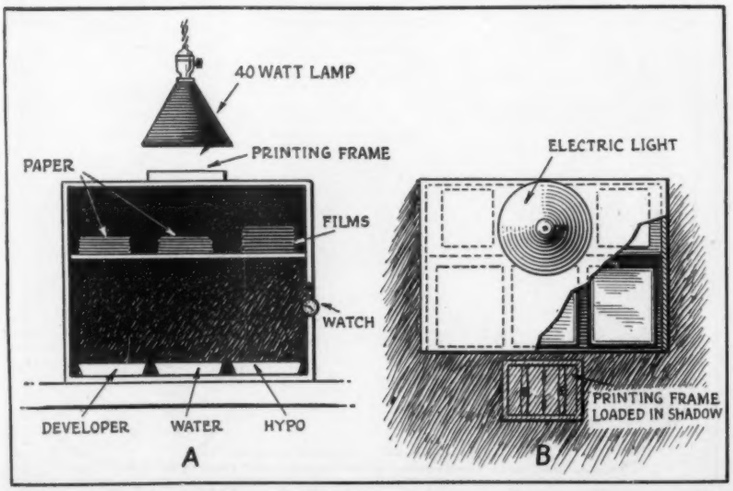
HAVE you ever seen a sign that stated that films left up to ten o'clock in the morning will be delivered by five o'clock in the afternoon? Seeing this, did you ever wonder how it was possible to accomplish the work that is entailed in developing, drying and printing in such a short time? The answer is that carefully designed apparatus and a well-planned system speed up the work. While the machinery used in these large photograph finishing plants is far beyond the amateur photographer, and would be of little benefit to him if he should be able to get it, still some of the methodical processes followed in the wholesale finishing work may be copied with benefit.

One of the simplest forms of printing arrangements that will be found suitable for the majority of amateur work is illustrated in these columns. It consists of a wooden box, about two feet square, fitted with a shelf as shown and painted black inside. Three trays, one for developer, one for washing water and one for hypo, are placed in the lower section. Films from which prints are to be made, as well as various grades of printing paper of the correct size are piled up on the shelf as shown at A. Above and to the rear of the center of the box, an electric light and shade are hung as in B. The bulb should be rated at about 40 watts.

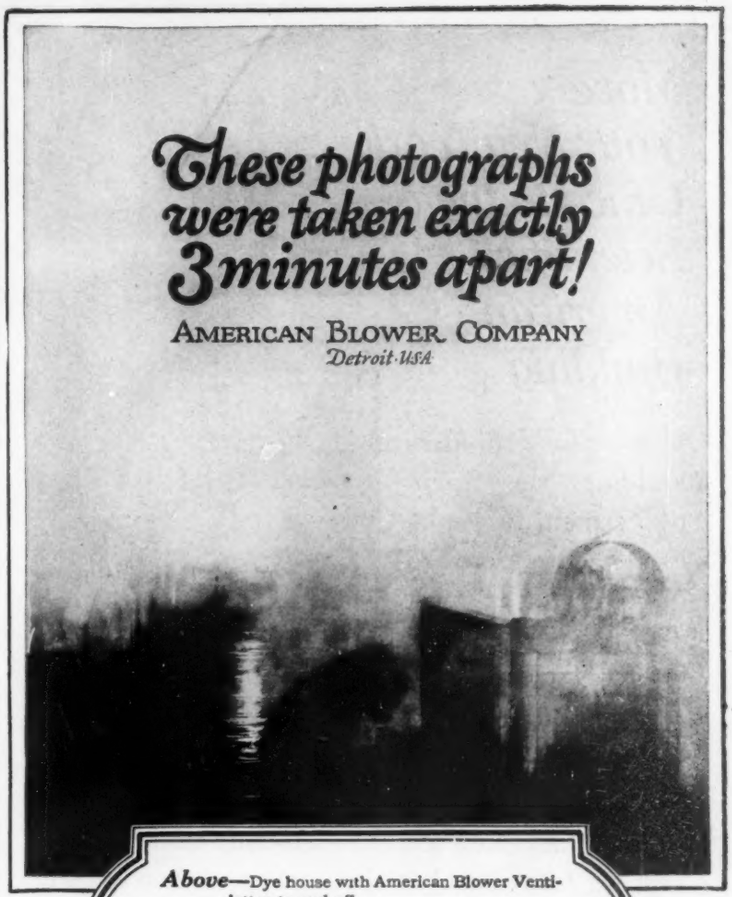
It will be found that the shadow cast by the box will be dark enough for the loading of the printing frame. The same condition also holds true with the location of the various trays. Since the reserve paper is placed face down on the shelf, there is no danger of its being light-struck; in fact, the shadow also prevents this.

A watch hung on the edge of the box will serve to determine the timing of exposure and development. In practice, this printing arrangement is used as follows:

A film and the required grade of paper are placed in the frame which is then laid, glass side up, on the top of the box under the light. When the proper exposure time has elapsed, which must be determined by experiment, the frame is returned to the shadow of the box and the paper is removed. Before starting to develop the print, the frame is reloaded and returned to the top of the box. The paper is at once placed in the developer. If the power of the light



The amateur photographer will find this cabinet very handy. When properly used, the work of printing and developing will be speeded up



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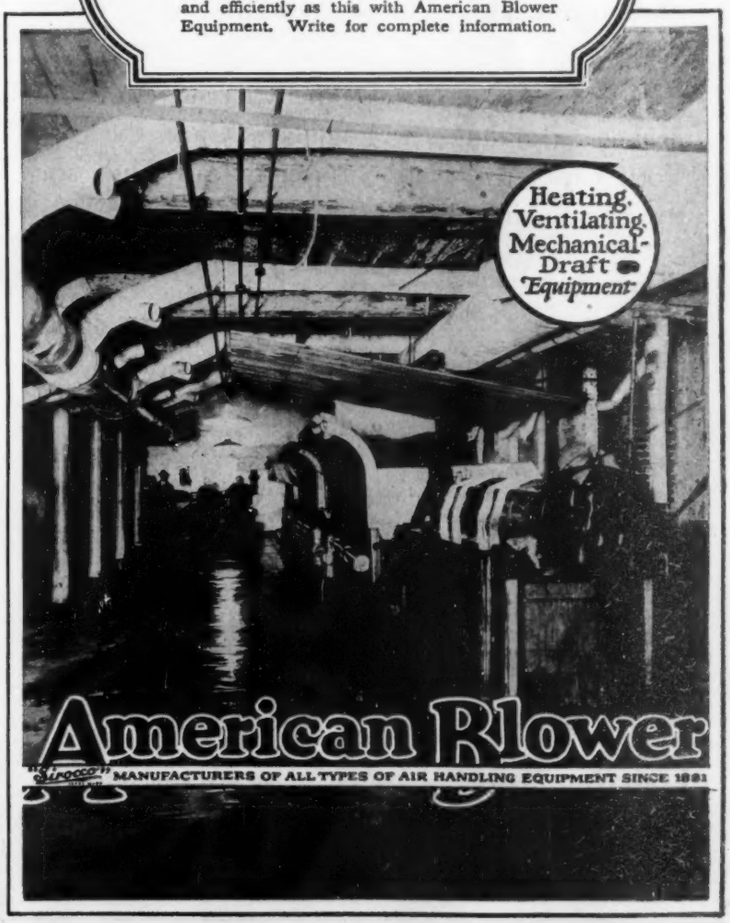
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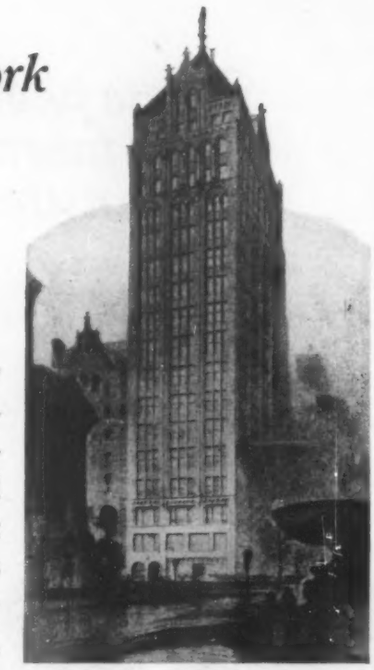

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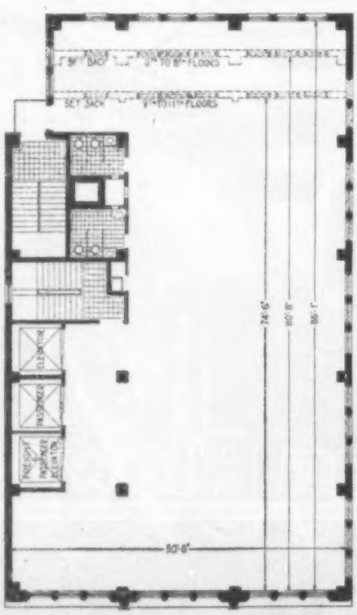

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is correct, this system can quickly be worked out to a point where the time of exposure will about equal that of development and placing in the fixing bath. Then the work can be carried on smoothly and rapidly. Of course, various thicknesses of negatives will tend to overbalance the system but proper attention to the developer, the lighting and the grade of paper used will tend to keep the method working properly.

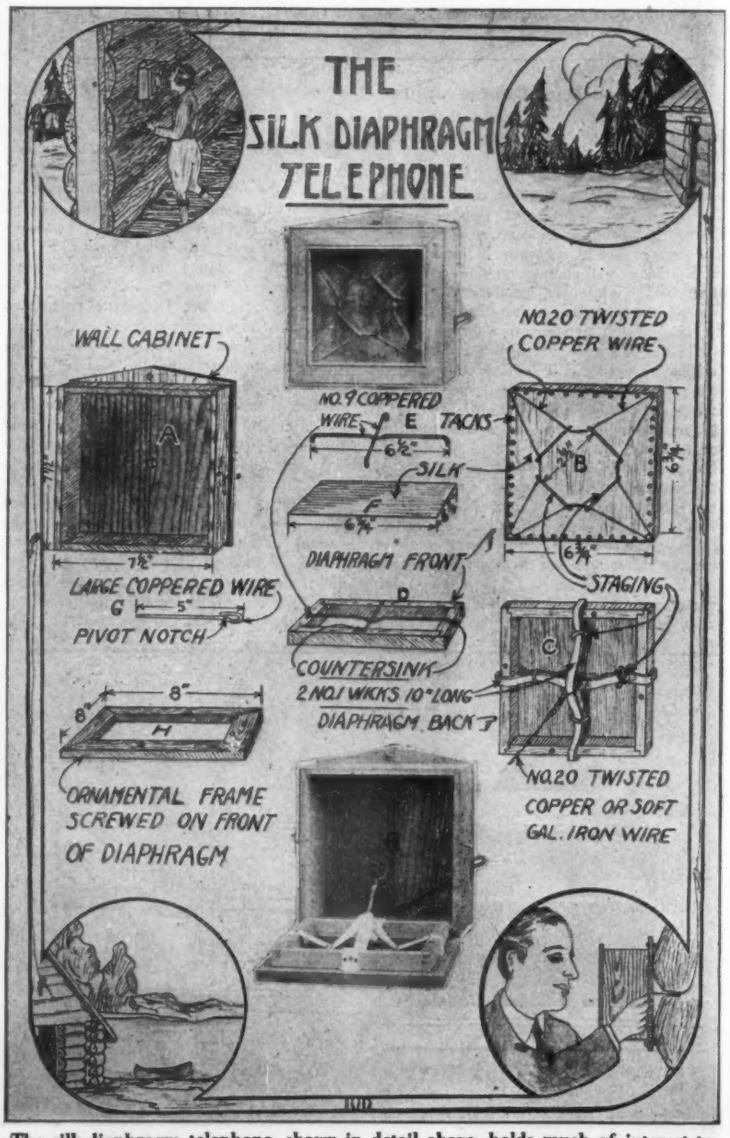
A Mechanical Telephone

THE fact that sound waves can cause a solid body to vibrate and transmit these vibrations throughout its mass is not new. Many of us, in our toy days, have used small mechanical telephones consisting of two diaphragms connected together by means of a string. It is not surprising then, that serious experimental work has revealed a method whereby the same principle that caused our toy telephones to work, can be applied to the construction of a telephone that will operate over comparatively long distances.

After trying various types of diaphragms for this purpose, the writer hit upon the idea of using pure silk. Investigation showed that this material must be as pure as obtainable. A mixture of cotton and silk is not at all satisfactory and other materials are far inferior. With two well made diaphragms, constructed as detailed below and a tightly stretched connecting wire with no bends or turns in it, the writer has carried on communication over a distance of approximately two miles. With a right-angle bend in the wire, good results were obtained at one-quarter of a mile. The value of such a system in camps and isolated districts is obvious, as the line has no operating cost and a low upkeep. [One of the editors of the Scientific American built a telephone similar to this one and found it satisfactory when used over a distance of 535 feet. Undoubtedly the results will vary greatly according to the materials used and the care with which the installation is made.—The Editor.]

The construction of the diaphragm, which is to be carried out in duplicate, should be done carefully, following the details given in the illustration reproduced in these columns. On the frame made of soft wood, four holes, diametrically opposite, are drilled half way through as shown at D. Two pieces of heavy copper wire are bent at their ends and inserted in these holes. The silk cover is then tacked over the frame, stretching it tightly but driving the large corner tacks only part way into the wood. A piece of number 20 copper wire is then placed loosely around these corner tacks, allowing enough slack for the wire to take the form shown at B when the staging is placed. The corner tacks are then driven home.

The next step is to turn the frame over and tack two ten-inch strips of number 1 lamp wicking in place as shown at C. The silk is now perforated at eight places and staging or heavy shoe string is threaded through the holes and around the lamp wick and the wire on the face of the diaphragm. It is then tied in place as at C. If the



The silk-diaphragm telephone, shown in detail above, holds much of interest to the experimenter. The principle might be applied to radio loudspeakers

slack allowed in the front wires is correct and the staging is pulled taut, the silk surface will be as tight as a drum head and in ideal condition for the purpose for which it is intended. The frame H should now be screwed to the front of the diaphragm support.

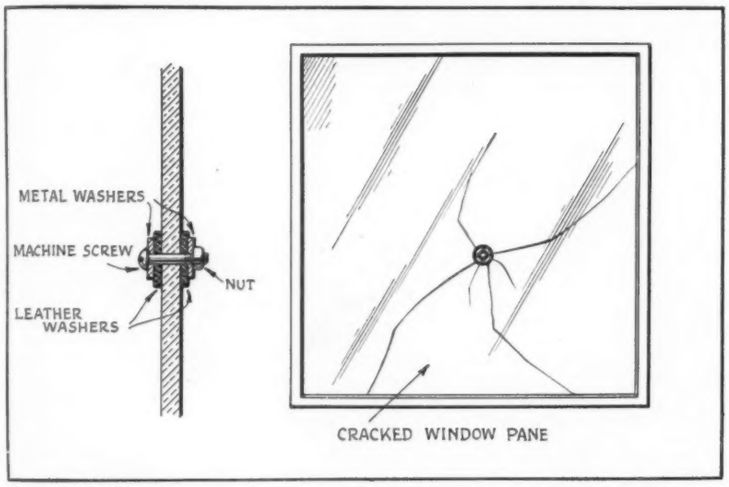
After the protecting box, A, is made, allowing a depth of four inches, the line wire is brought through the wall, being careful that it does not touch the sides of the hole, and is fastened to the intersection of the wicks. It is then stretched taut to the first insulator and this tightness is preserved throughout the line. Remember that right-angle bends in the wire will reduce the effective length over which communication can be carried on. While copper wire is to be preferred, soft iron wire can be used to reduce the cost. Stranded wire is found best.

For calling, the heavy wire G, pivoted in the side of the box, is shaken violently against the line wire, causing both diaphragms to give forth a loud rattle.

The two photographs in the accompanying illustration show one of the telephones that the writer built and used with the results mentioned above.

Contributed by TUD GARVER.

[EDITOR'S NOTE. This contribution puts forth a pretty problem in acoustics and in the transmission of mechanical vibrations along a metallic wire. As the author points out, the material used in the construction of the diaphragm enters largely into the proposition. It would seem that a series of experiments along this line would be intensely interesting and there is a possibility of improving the results. If any of our readers, in using one of these mechanical telephones, finds any noteworthy results, we will be glad to hear of them. In a letter to the editor, the author suggests that the findings with the silk diaphragm may be applied to radio loudspeakers. Why not try it and let us hear of the results?]



A cracked window pane is dangerous, as the pieces may fall out of the frame. Here is a way to prevent such a happening

Broken Window Repair

WHEN a pane of glass cracks and there is not time or the facilities to install a new one, the following kink will come in handy. When a window is broken by reason of a blow, there are usually several cracks formed, radiating from the point where the pressure was applied. Examination will show that there is probably a small hole at the intersection of these cracks, but if such is not the case, a hole can be made, and made with safety if care is taken.

Regardless of how the hole is obtained, it is necessary to the use of this repair stunt. The only requisites are a small machine screw, two leather washers and a nut to fit the screw. As shown in the illustration, one of the washers is placed on the screw, the latter is pushed through the hole in the glass, the other washer is put over the screw and the nut is spun home. The nut should be tightened sufficiently to hold the broken pieces of glass in position. If the hole in the glass is comparatively large, the leather washers should be backed up by two metal washers, one under the head of the machine screw and the other under the nut as shown.

If no leather washers are at hand, they can easily be cut from a scrap of leather or the side of an old cast-off shoe. For the sake of neatness, they should be cut round. The hole in the center should be cut just large enough to slip over the machine screw to be used.

Preserving the Storage Battery

THE storage battery in the electrical, radio or physics experimental laboratory is one of the items that does not receive as much attention as it should, and as a consequence, it is the one accessory that is liable to go wrong just at the time that it is most needed. If, however, the following suggestions are heeded, the battery may be expected to deliver the best possible results at all times.

Absolute cleanliness should be observed in the care of storage batteries of the lead-plate type. If moisture and dust are allowed to collect on the tops of the cells, the result will often be that the terminals will be connected, through a rather high resistance (the dampness and dust), and the battery will, in a short time, be totally discharged. This condition is often hastened by carelessness when adding water to the cells. While this water is, or should be, distilled, a conducting path is formed when the water mixes with dust on the top of the battery.

When it is noticed that the battery looks grimy, moisten a clean cloth with ordinary household ammonia-water and carefully wipe off the tops of the cells. Work around the terminals and under the connecting straps.

Storage battery terminals should never be allowed to become corroded. When the bluish or greenish tinged mass appears, denoting that corrosion is at work, remove it with a knife blade or similar tool. When the metal has been scraped bright at each terminal, coat it with vaseline or other heavy grease. This will delay the action of corrosion.

These, together with the usual precautions of regular charging and addition of water, will be of great assistance to the battery and will prolong its life.

Loosening Stubborn Stoppers

WHEN a glass stopper in a bottle becomes stuck, do not try to force it, as you will be apt to break the bottle. Instead, light a match, tip the bottle slightly and very carefully apply the flame to the neck. Rotate the bottle so that no one part of the glass will get too hot and crack. The heat of the match will expand the glass of the neck and so loosen the stopper.

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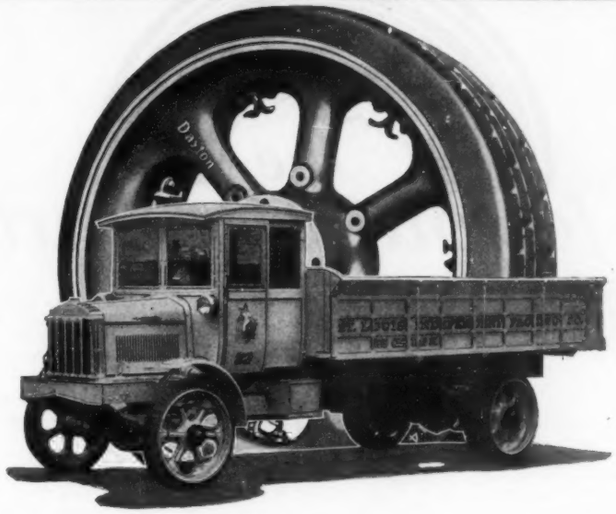

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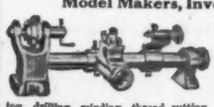

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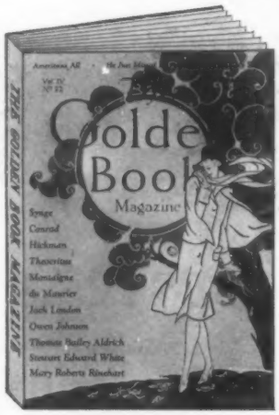

The Fun of Growing

"Happiness consists in this," said one of the wisest of men (Spinoza) *"that one's powers are increased."* The more you grow, the more there is—and the more different kinds appear. The very sense of growing is one of the most exciting things this existence contains.

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Some of it belongs to you.

It is full of knowledge about Man: animal, poet, philosopher, statesman, merchant, fighter. There are things in it that increase your powers, give you more insight into other human beings, wake new ideas in your mind. For Knowledge really is Power: where other qualities are at all equal, it is the man who has thought most who makes the largest material success in life—more important, who gets most out of life.

The Road to Culture

There never was a nation that strove harder for Culture than ours. And it is worth having—simply because it helps you to suck out of life the pleasures that mean most to you.

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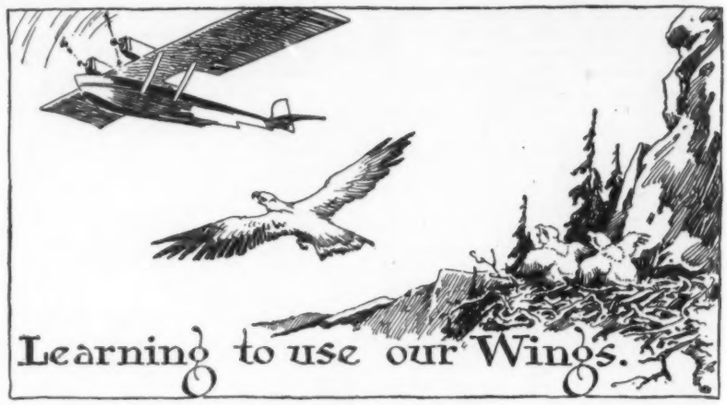


Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

The National Air Races

THE National Air Races held at Model Farms Field, Philadelphia, during the week of September 4 to 11, proved disappointing in spite of the many events, handsome trophies, valuable prizes and long preparation. Bad weather and poor drainage caused an annoying break in the series of events. There were no real racing planes present to make another world's record such as we used to associate with the Pulitzer trophy. There were no radical developments noticeable in either planes or engines, and there is always a real difficulty in making any long drawn out airplane meet interesting. An itemized recital of this year's events would read just like that of last year's races.

There were however, a few interesting novelties. For the first time in American air racing there was a parachute contest, Special Event "B," which provided a daily thrill for the spectators. The parachute artists jumped from an altitude of 1,500 feet once a day and tried to get as close to a given mark as possible. Fifty dollars was the daily reward for the best attempt. The final prize of 250 dollars went to W. B. Baird who made the week's record by landing only 89 feet from the mark. The contest has a practical utility. It is not sufficient for the parachute jumper to land at a moderate rate of speed; he must to some extent be able to guide himself and avoid tree-tops, church steeples and other obstacles!

Another departure from conventional air racing was the "Valley Forge" Trophy contest in precision landing. The trophy was the gift of Dr. Thomas E. Eldridge of Philadelphia. Contestants were required to climb to a height of 1,000 feet, cut their motors and glide for a chalked circle. The weather was gusty, and fliers had to adopt a variety of flying devices, some making a long glide close to the ground, others killing speed by "fish tailing." In spite of unfavorable conditions the fliers all landed but a few feet short of the mark. Douglas Davis won the contest in a Waco by landing only five feet from the circle. Such accuracy is of interest in commercial flying, particularly in restricted territory.

The real difficulty in racing is that the spectators see plane after plane coming round the pylons with monotonous regularity, have to wait so long for the final result, and do not see a neck to neck finish very often. However, one novelty gave them something more to see. This was the Benjamin Franklin Trophy relay race, in which three teams of three planes each were entered. After making one lap of the course, a plane of a given team would land as near a certain flag as possible, the passenger would get out, grab the flag and run back and tie the flag to the next plane of his team as rapidly as possible. The winning team consisted of Basil Rowe and Casey Jones each in Thomas Morse planes and A. H. Kreider in a Waco 9.

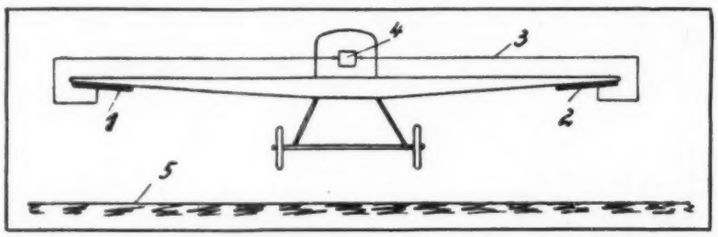
A striking incident was the changing of the engine on the Pitcairn *Sesqui-Wing Arrow*. Designed for a race in which it was possible to use a high-powered engine, it was equipped with a Curtiss C-6, six-

Pursuit plane rounding pylon at the National Air Races at Philadelphia

cylinder vertical engine. Then the owners of the plane decided to enter it for a race where only an engine of 510 cubic inches displacement could be used and an OX-5, 90 horsepower engine, an eight cylinder V, had to be substituted accordingly. To make the change, a rough wooden scaffold was erected on the field with a steel cross beam on which ran two heavy tackles, one for taking the engine out and one for putting it in. Ingenious devices for "centering" the engine and for changing the ignition, instruments and fuel and oil connections allowed the whole operation to be accomplished in 31 minutes. Such methods are of immense interest to air-line operators as they show that the removal of an engine for repair or overhaul will not immobilize a plane for any length of time.

Perhaps the most striking points about the meet in general were the disappearance of old war-time types. Not a "Jenny" and but one old-time Standard were present. The OX-5 engine was present on many planes, but the more modern engines such as the Wright Whirlwind were seen in equally great numbers. The efficiency and reliability of air-cooled engines received another endorsement. Perhaps 90 percent of all fuselages on the field were of the steel tube type. There was steady progress all round, even if there was nothing startling.

At the close of the races, there was a demonstration of "The Voice from the Sky." On the underside of the Sikorsky *S-29* was fitted what looked like a loud speaker.



A height indicator which operates on the principle of a condenser; the capacity between the plates 1 and 2 and the ground 5 changes with the height

With engines throttled, and at an altitude of about 1,200 feet the voice of one of the crew singing a popular song could be plainly heard by the crowd. Perhaps there is in this the possibility of another advertising method.

Suggestions for Future Races

IT seems amply demonstrated at the recent National Air Races that small planes can be built to have the efficiency of racers and to be perfectly airworthy. In the 300 cubic inch classification for next year's races it would seem to be a pity to ask for speed and nothing else. Surely it would attract more interest and serve general development better if two-seaters were insisted upon. Also, following the example of the British light-plane meet at Lympne, why not include tests of the rapidity of disassembly and re-assembly and allot points for the dimensions within which the planes can be housed.

The race would thus serve a more useful purpose and lead up to sales to the general public. A test of the ability to clear a 25-foot barrier after a 300-yard run would also enhance the value of the race, since it would involve a feature of considerable importance to the safety of airplanes when making get-aways in restricted fields. Perhaps the authorities of the National Aeronautic Association will give some attention to these points in the near future.

A Height Indicator

THE Army Air Corps has been experimenting with a height indicator for several years. This device functions when the plane is approaching the ground and should be particularly useful, in fact almost indispensable, when flying in fog. From *Flugsport* it would appear that the Junkers Company has taken out patents for a similar device. This is shown diagrammatically in these columns. At the two ends of the wing are placed horizontal metal plates, 1 and 2, of large area, connected by a wire, 3, at their ends. The two metal plates thus form the elements of a condenser of very slight capacity. When the plane approaches the earth, the capacity of these plates increases very rapidly because the earth itself is a conductor. If the plates are therefore part of an oscillating electric circuit, the variation of capacity on approaching the ground can be readily made to give a warning signal by methods familiar to radio engineers.

Planes of Limitless Size

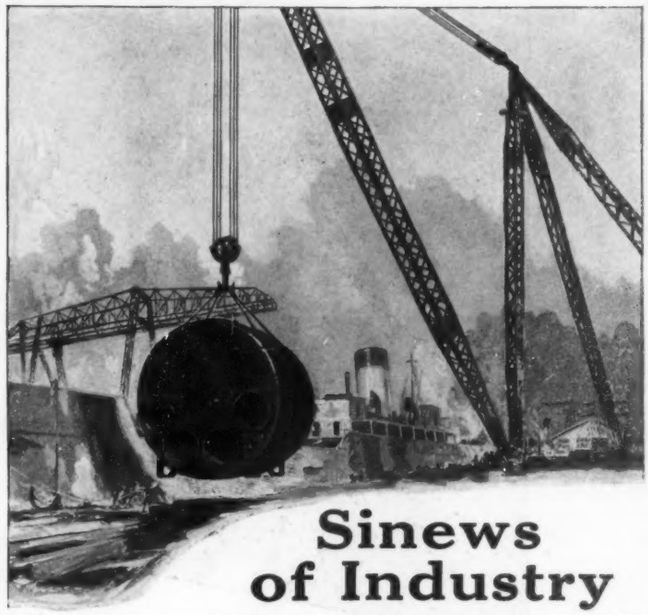
MANY authorities believe that the airship, because of its load-carrying capacity and long range will ultimately be the means of fast transportation across the Atlantic. On the other hand, a number of German constructors are convinced that they can develop the airplane to the point where it will be capable of crossing the ocean at even greater speed than the airship, carrying sufficient fuel and a commercially profitable pay load of passengers and cargo without such overloading of the wings as was necessary in the ill-fated Sikorsky *S-35*.

The problem is not an easy one. It is not enough merely to increase size. For geometrically similar airplanes, with the same landing speed, the lift increases as the square of the span or any other linear dimension, while the structural weight increases as the cube of the linear dimension. In theory, therefore, the structural weight of the airplane will bear a larger proportion to the gross weight of the craft as the dimensions increase. Ultimately a point is reached where the structure weighs so much that no surplus remains for carrying fuel, much less pay load.

In practice, the theoretical law does not apply, because with large craft the maneuvers are not so violent, high factors of safety are not so necessary, and many devices in design allow the weight of the large plane to be kept down. But it will apply finally for really huge craft such as have not been attempted hitherto.

How then are we to build giant planes in which the structural weight is to be kept down? Roughly speaking, the wings of an airplane are analogous to a cantilever bridge. As the span of the wing increases so does the bending moment at the root of the wing where it attaches to the body. Increased bending moment means more material in the spars and more weight. Therefore, why not have several fuselages, and distribute the load all along the wing? Surely this will relieve the strains and lighten the structure. The idea of distributing the load along the wings is not novel, and has been suggested in many quarters.

Dr. Rumpler, a well known German constructor, has carried the idea beyond the suggestion stage and worked out in detail a design which is of real interest. His plane is shown in its suggested form. Instead of the customary one or two floats as in the conventional seaplane, he proposes to use six floats, four of which are to extend to the tail control surfaces. This is the first step in load distribution and diminution of the bending-moment strain. Further, instead of one concentrated engine and fuel load, ten engines of 1,000 horse-



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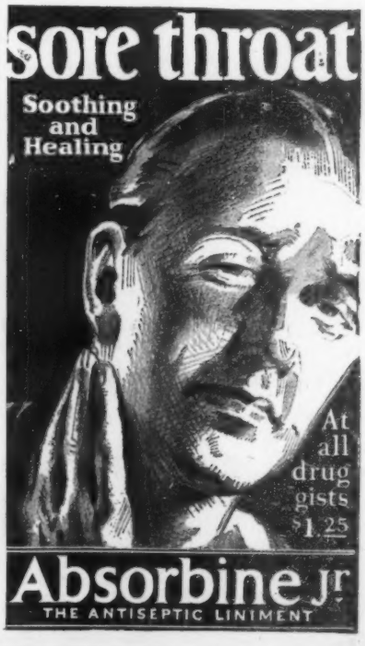

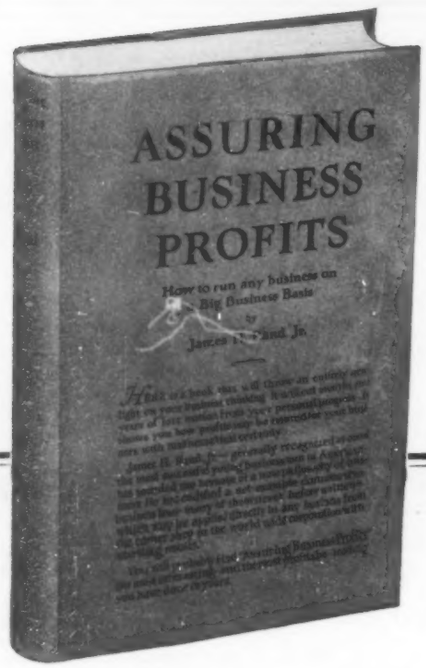

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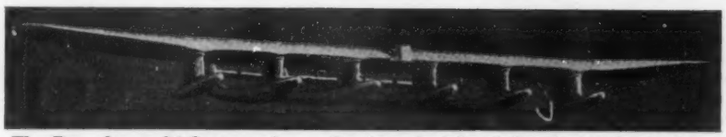


The Rumpler multi-float seaplane. By the principle of distributing loads along the span, the weight of the structure may be considerably reduced

power each are to be disposed along the length of the wing, with fuel tanks likewise distributed, the engines driving ten propellers through gearing. (The engines and fuel will be in the wing and the gear- and shafting-driven propellers are to be disposed in tandem between the floats.) The passengers are to have their quarters inside the wing which will be large enough to provide sufficient room for living, sleeping and dining. Passengers and cargo are likewise to be distributed along the length of the wing.

According to Dr. Rumpler this principle of load distribution will so lighten the structure that instead of the usual 35 percent, the "plane of limitless size" will have 50 percent of its gross weight in useful load (that is, fuel, oil and cargo). Therefore it will have ample fuel for crossing the Atlantic in an uninterrupted flight, and to carry a real pay load at the same time.

Besides the advantages of range and pay load, greater security is claimed for such a type of craft. With ten engines, each with a separate fuel system, it is inconceivable that power-plant troubles should ever bring the seaplane down. The large number of floats and its huge dimensions will make it seaworthy in the roughest sea. Mere size will increase its stability in the air as well as its seaworthiness.

The design is so well worked out that it is possible to regard the data accompanying the plans with confidence. The gross weight is to be 253,000 pounds; the pay load is to be 44,000 pounds including 130 passengers with 13,200 pounds of baggage, mail and express matter; the fuel load is to be 81,700 pounds, sufficing for 16 hours flight at full throttle, with ample reserve, or for 27 hours at a cruising speed of 125 miles per hour giving a range of some 3,375 miles. The wing area is to be over 10,000 square feet, and the span nearly 300 feet.

Perhaps this superplane is not so many years distant.

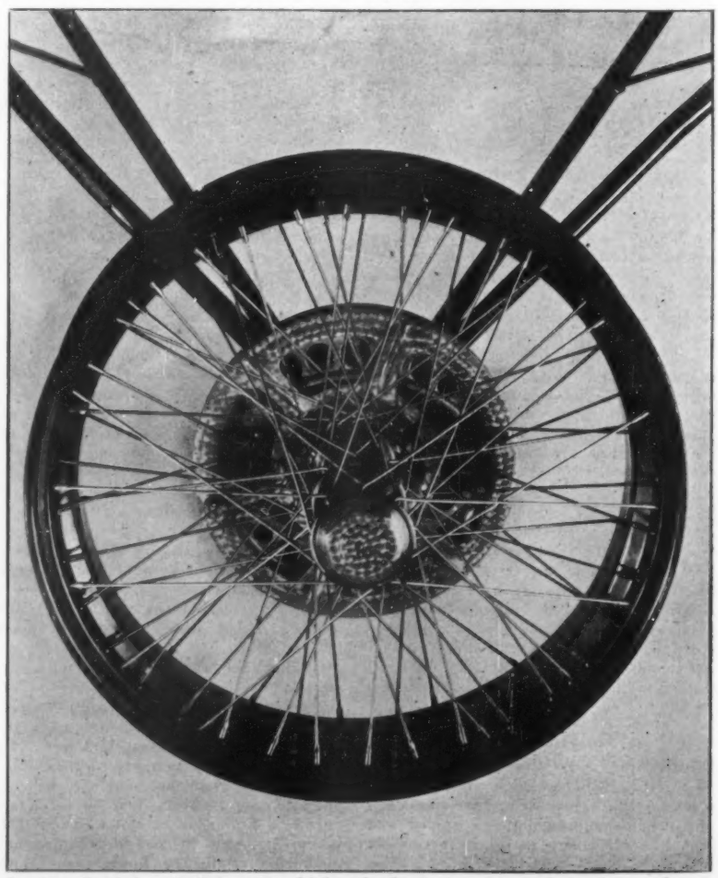
An Airplane Wheel Brake

THE application of brakes to airplane wheels is proving very useful. They shorten the landing run, do away with the necessity of ground tackle or of men hanging on to the wings at the start of the plane, and when acting independently on either wheel, facilitate steering on the ground. The Sauzedde Wheel Company has now brought out a wheel for airplanes in which the brake mechanism is an integral part of the wheel. This arrangement is now in use on several types of planes. The wheel is of light construction with spokes, hub and axle of an alloy composition. There are three banks of spokes, 32 in one and 16 in each of the other two. The brake mechanism is self-energizing and operates with equal force during forward and reverse motion of the wheel. A wire, usually enclosed in the steel-tubing struts of the landing gear, transmits the force to the brake from the rudder-bar pedal.

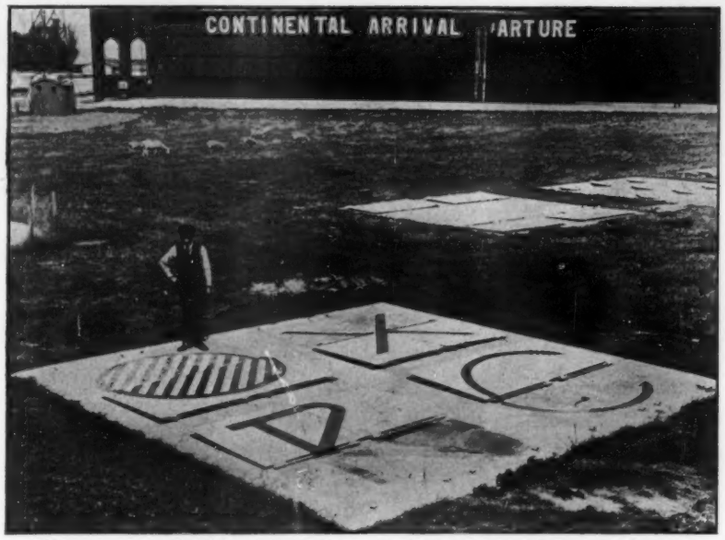
Signaling the Airman

THE British Imperial Airways, operating between London and Paris, shows a freedom from accident, which is definitely superior to the record of any other European air line. This is due partly to the excellent equipment and partly to the splendid ground organization which is being constantly improved.

While all British transport planes are equipped with radio receiving and trans-



A wire wheel for airplanes, in which a brake is incorporated, is shown above. The feature of the brake has many advantages for the airman



Signs used at English airdromes to signal weather conditions to airmen

mitting sets and obtain information on the weather at any time, a system of visual weather signaling to the pilot has long been considered desirable. It is only recently that a simple yet effective system has been devised. On the various English airdromes huge signs are now installed, consisting of hinged "doors" which can be opened or closed as desired. The sign at the top left of the device above, means rain or drizzle; top right; snow, hail or sleet; bottom left, thunderstorms or line squalls; and bottom right, gales. The men in the lower photograph are shown busily shutting down the signs.

A Neat Touring Plane

THE Focke Wulf twin-engine touring plane which has recently passed its flying tests at Adlershof, Germany, is one of the neatest designs to be seen either in the United States or abroad. Its wing is a monoplane, entirely without external bracing and of exceptionally good aerodynamic form. The engines do not form an unsightly protuberance above the wing, nor are they supported by a more or less complicated structure of tubing; they blend perfectly into the wing itself, disturbing the air flow to a minimum degree. The engines are air-cooled, yet no projecting cylinders are in sight; they are the Junkers type LI of 75 horsepower, in which the air is drawn in at the front end by a blower mounted on the propeller shaft, and then guided in special passages so as to give uniform cooling to all six cylinders (as recently described in our columns).

The pilot is seated where his vision in all directions is excellent, but he is fully protected by a windshield which can slide up or down, and is *not* at the very front end of the machine where the main impact of a crash is felt. Three or four occupants can be comfortably seated in the passenger cabin.

A great deal remains to be done in the problem of eliminating noise in the passenger cabin. The Focke Wulf plane shows a step in the right direction by providing a double veneer wall for the compartment so that it is insulated from noise.

We have become so accustomed to the long, stilt-like landing gear of all types of airplanes that it is a relief to see a cantilever form of chassis with solid stubs projecting directly from the sides of the fuselage in a horizontal plane. The resistance of the chassis to the air stream is thus reduced to a minimum. This landing gear design has still another advantage; since the engines are mounted in the wing, there is enough propeller clearance and yet the fuselage is but a foot or so from the ground. The passengers have only a step to make to get into the cabin and the tendency to nose over on landing is slight, because the center of gravity is not high above the ground.

The propellers swing forward of the pilot's head. When propellers break, the thrust which is present on the blades carries the released elements forward and sideways. There is no guarantee, even in this design, that breakage of the propellers may not injure the pilot, but at least the danger is minimized.

The weather signs are made to disappear by the simple process of turning the various large "doors" about their hinges

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From the office of

Mrs. Ballington Booth
34 West 28th Street
New York City

December 1, 1926.

To the Editor,
Dear Sir:

Will you allow me, through your columns, to appeal to your readers once more on behalf of the wives and little children of the men in our prisons.

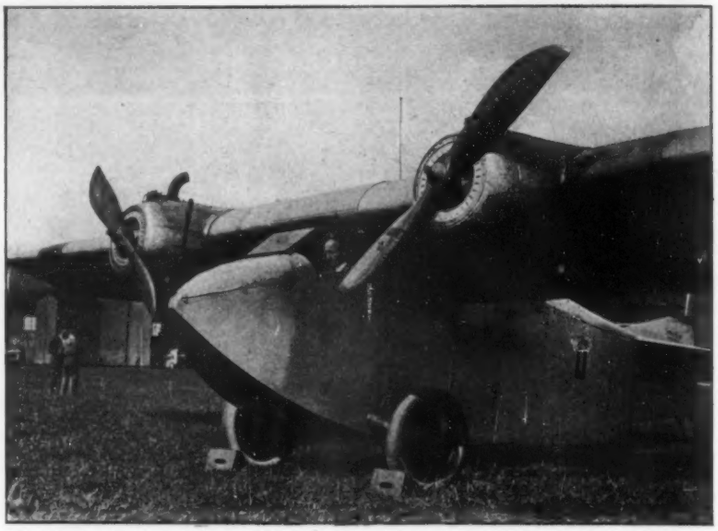
My close touch with the prisoners of this country brings me more and more into contact with these many needy families. We try to make our Christmas gifts most practical. Something that will last through the winter, not only for the brightening of one day. Therefore, in addition to Christmas cheer and toys, we send warm new clothing and hundreds of pairs of shoes for the little feet that must tramp to school through mud and snow and which, but for our help, would be poorly shod.

Will the readers of this message help me? We try to make every dollar go as far as possible. Checks, clothing or toys should be addressed to Mrs. Ballington Booth, 34 West 28th Street, New York City.

I might add that The Volunteers of America is a duly incorporated organization; that our accounts are carefully kept and audited and receipts sent out for every gift.

Believe me,

Very truly yours for our
Country's prisoners,
MAUD BALLINGTON BOOTH.



The Focke Wulf touring plane of exceptional design. The cantilever chassis brings the fuselage close to the ground. Such a plane, with its enclosed cabin, is bound to make a strong bid for popularity

We have often emphasized the possibility of making a long glide with one engine of the two not functioning. The Focke Wulf plane, fully loaded with pilot, three passengers, 145 pounds of baggage, and fuel for three hours flight at full throttle has made a flight on one motor of nearly five miles and lost only 300 feet altitude in the process. This plane certainly seems worth careful study by American designers.

Learning to Fly

THERE are hundreds, perhaps thousands of young men in the United States who wish to learn to fly; some because they wish to become professional pilots and air operators, some because they wish to acquire a modern and useful accomplishment and to feel the thrill of man's latest achievement over nature. To such men a variety of plans are open. They may proceed to one of the many excellent flying schools now found in every part of the country, and for a few hundred dollars learn to "solo" in ten or fifteen hours' instruction and in many instances acquire also the rudiments of the mechanics of plane and engine.

The difficulty with the graduates of such schools is that their brief flying training does not fit them for really responsible flying work. If they choose, however, to enlist in the Army Air Corps, they may secure far more comprehensive instruction, involving several hundred hours in the air, and be paid while in training.

A book issued by the Ronald Press, "Aircraft and Airmen," by Major Henry H. Arnold gives a very faithful picture of the training which may be secured in this service and is also a most interesting introduction to flying in general. Before being accepted for the physical examination a candidate must show that he is unmarried, a citizen of the United States, between the ages of 20 and 27 years, a high school graduate or of equivalent education and of excellent character. If he complies with these requirements, he may be ordered to report at one of the active aviation fields where is given his physical examination. This is the most severe ever devised and includes every part of the body. Special attention is given to the ears and eyes, to the sense of balance and to quickness of reaction. A mental examination follows, except for those men who have graduated from high school within the two preceding years.

After passing both the physical and mental examination, the candidate is assigned to the United States Army Primary Flying School at Brooks Field, San Antonio, Texas, starting with his class either in March or September. A flying cadet enlists for a period of three years, but is discharged either upon completion of the entire flying course of one year or upon failure to complete the course. As a cadet, he receives pay of 75 dollars a month and additional dollar a day for food.

Major Arnold is thoroughly familiar with every phase of Army flying. He gives a most vivid picture of the cadet's training and fascinating, although arduous duties. The first few days are devoted to military exercises and the development of the soldier's viewpoint. On the twenty-fifth day, the class is divided into sections of six cadets. Each section is assigned to an instructor for flying training. "Naturally the first airplane ride is an interesting event for every cadet," says Major Arnold. "Many are afraid that they will not like the ride or become scared, or get sick in the air, but upon landing from the first flight, the wonder is why they had any fears at all. It was enjoyable—so different from what they had anticipated."

Daily flying instruction occupies about three-quarters of an hour. The remainder of the morning is devoted to servicing planes, cranking engines, trouble shooting and similar duties. The student absorbs considerable mechanical information in the process.

In the actual work in the air, the instructor sits in the front cockpit and the student in the rear, both having a complete set of controls. At first the student is given the joy-stick for elevator and aileron control and told to keep the plane flying on a even keel, The pupil "over-controls" at first, causing the plane to wobble and jump. The use of the rudder comes next. After he has learned to keep the ship on an even keel and on a straight course, he makes gentle turns, then sharp turns and figure eights. Then follows the painful process of making landings; the student lands again and again until he has mastered this difficult art.

Then comes training in spins, Immelman turns, et cetera. At the end of some ten or fifteen hours' instruction the student makes his first "solo" flight. "The student is not given an opportunity to worry about the prospective solo flight," says Major Arnold, "because when the student least expects it, the instructor will jump out of the plane and say, 'take it up by yourself.'" The student then receives instruction in "precision flying," ground instruction in radio, gunnery, engine and plane assembly and disassembly, and finally graduates in about six months. He then goes on to the Advanced School at Kelly Field, Texas, where he passes from the training plane to advanced service types, and applies his knowledge of flying to specialized work in Army observation, bombardment and other military branches of aviation.

A man who qualifies at the end of the year is not only a reserve officer of real value in the scheme of national defense, but a man whom commercial aircraft operators have learned to respect and often select for both flying and for ground work in connection with various commercial services.

To Increase Subway Service

In several cities, the problem of relieving congestion in subways has become large. In New York City it has been proposed that the station platforms be lengthened and more cars run in each train. Of course, this would help to a very great extent, but the cost is huge. To solve this difficulty and to allow the use of longer trains with the present platforms, one of our readers has evolved a train plan that is explained in the letter reproduced below.

Editor, Scientific American:

The plan for subway trains that I have designed and upon which I have been allowed a patent may be described in the following manner: The trains are longer by one half, and divided into three sections, each of which is marked in a distinct identifying manner. Each station is divided into two sections, marked to correspond with two of the train sections.

The operation of the plan is as follows: The three sections of the train may be marked with red, white and blue. Then each odd station will have one half of the station red and the other half white. At this station the red and white sections of the train will stop at the platform and the blue part will be in the tunnel. At each even station the white and blue sections of the train will align with the platform and the red part will be in the tunnel. With proper posting of directions for passengers the plan can easily be worked out at a great saving to the transit companies, and with a huge increase of rush hour service.

Robert H. Rippere,
Brooklyn, New York.

Suspicious Humanity

A little while back, the magician, Houdini, allowed himself to be sealed in an airtight coffin and sunk beneath the waters of a swimming pool in a New York hotel, as a guarantee that he had no secret access to air. He came out one hour and 31 minutes later, alive but rather exhausted. He was trying to show, he said, that a person while relaxed and quiet breathes very little air, and that the previous attempt of a Levantine to perform the same feat on a self-asserted basis of "going into a trance" was insincere. In spite of these facts, many people believed Houdini took compressed oxygen into the coffin with him, or did some similar "stunt." In the following letter the manufacturer of the Pulmotor refutes these assertions. Houdini had no need to resort to tricks. There was air enough in the coffin provided he kept quiet.

Editor, Scientific American:

I have just been doing some figuring with the data before me regarding the recent trick performance of Houdini. It is possible that you may be interested in a brief résumé of the matter.

I am informed by the Rockefeller Institute that the specific gravity of the human body is approximately 1.0. The dimensions of the case in which Houdini remained were 6½ by 2½ by two feet, according to the figures given to me. I have assumed that Houdini's weight was 180 pounds. This indicates that there were 29.578 cubic feet of air available in the case after deducting the space occupied by the body.

According to Henderson and Paul in their Technical Paper Number 82 for the Bureau of Mines, the average volume of oxygen consumed by a man resting in bed is 0.237 liters per minute. In order to allow a liberal margin for the possibility of any excitement which might be caused by an undue nervous strain of a man under the circumstances in which Houdini was placed during this test, I have increased this consumption of oxygen to 0.3 liters per minute.

If I recall the results of the test correctly, Houdini remained in this case for 1 hour and 31 minutes. I have made this 1 hour and 40 minutes, to be liberal again.

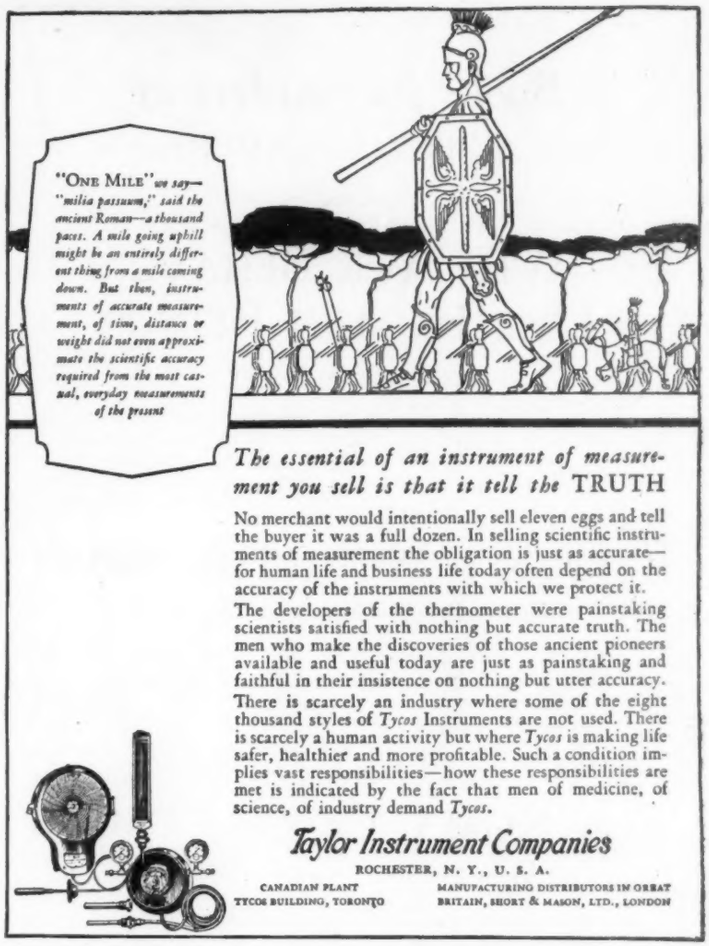
With these figures it would appear that a total of 30 liters of oxygen were consumed during the test. By converting the above number of cubic feet, namely 29.578, to liters, we have approximately 837 liters of air available, or approximately 176 liters of oxygen. About 17 percent or 30 liters of this total oxygen was thus consumed during the test, and approximately the same amount of carbon dioxide given off. There was approximately 21 percent of oxygen in the air originally. therefore 3.5 percent of the total amount of air was apparently used in this test. If you will refer to page 25 of Technical Paper Number 82, you will notice that, "the blood of a normal man or animal at sea level is unable to absorb oxygen fully when the proportion in the atmosphere that he is breathing falls below about 13 percent." In this case, however, the figures would indicate that there should have been over 17 percent remaining. If you will further refer to the report on pages 28, 29 and 30, you will see the effects of insufficient oxygen, and on pages 30, 31 and 32, the effect of carbon dioxide on inhalation.

It would appear, therefore, that the theoretical percentage of oxygen and carbon dioxide which remained at the end of the test by Houdini are well within the range of possibility without there being the slightest bit of trickery involved. I think that the only reason that Houdini was unable to remain longer under these circumstances was due to the fact that his system had been gradually accumulating the toxic effect of the carbon dioxide for a considerable period of time, which made it impossible for him to breathe any longer with safety, owing to decreased vitality.

F. F. Morris, President,
American Atmos Corporation.

Credit Where Credit Is Due

Since the publication of the October issue it has been brought to our attention that three of the excellent mural paintings which we reproduced in connection with our digest article "Mastodon or Mammoth" (page 289), and which we credited merely to the American Museum of Natural History, were the work of the well known painter of animals, Mr. Charles R. Knight.


"ONE MILE" we say—"milia passuum," said the ancient Roman—a thousand paces. A mile going uphill might be an entirely different thing from a mile coming down. But then, instruments of accurate measurement, of time, distance or weight did not even approximate the scientific accuracy required from the most casual, everyday measurements of the present
The essential of an instrument of measurement you sell is that it tell the TRUTH
No merchant would intentionally sell eleven eggs and tell the buyer it was a full dozen. In selling scientific instruments of measurement the obligation is just as accurate—for human life and business life today often depend on the accuracy of the instruments with which we protect it.
The developers of the thermometer were painstaking scientists satisfied with nothing but accurate truth. The men who make the discoveries of those ancient pioneers available and useful today are just as painstaking and faithful in their insistence on nothing but utter accuracy.
There is scarcely an industry where some of the eight thousand styles of Tycos Instruments are not used. There is scarcely a human activity but where Tycos is making life safer, healthier and more profitable. Such a condition implies vast responsibilities—how these responsibilities are met is indicated by the fact that men of medicine, of science, of industry demand Tycos.
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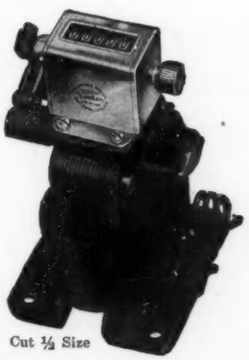

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HARPER & BROTHERS - *New York City*

The reader with scientific inclinations, when he comes to New York, will quite likely visit this great museum. Here he will see the originals of Mr. Knight's paintings—which were made under the supervision of Dr. Henry Fairfield Osborn, the noted paleontologist—adorning large expanses on the walls of the exhibition halls. Most of them depict extinct animals in their reconstructed environments. The combination of an artist with scientific leanings helped by a scientist of artistic leanings assures the public that the details are as authentic as our present knowledge permits.

A Tame Humming Bird

It is seldom that one hears of the capture and taming of one of these elusive little creatures that have the faculty of being able to remain practically stationary in the air, suspended by wings that are moving so rapidly as to be almost invisible. However, we have a record of such an occurrence in the form of the letter printed below. A photograph of the humming bird appears in these columns.

Editor, Scientific American:

On May 13th of this year, my daughter picked up on the sidewalk, three blocks from home, a very young humming bird that evidently had fallen from the nest. Failing to locate the nest, she brought it home. The problem of feeding was solved by putting a few drops of honey weakened with water in a flower, the flower being held close to the bird's beak. It soon learned to drink out of a small cup.

As soon as it was able to fly (in about

A tame humming bird hovering at the edge of a cup. Note that the wings are almost invisible

three weeks) it was released to make its own living, but it returns to the screen door three or four times a day since it was released and calls to be fed.

The photo shows the bird supporting itself by its wings while feeding from the cup. Occasionally, however, it settles on the cup to feed. When first released other humming birds helped feed it. However, it will not allow the other birds near the cup.

For about two or three weeks after it was first released the bird returned to the house every night to sleep.

(Mrs.) Frank Minter,
Ontario, California.

Cows and Milk in Florida—a Correction

The Scientific American Digest recently carried an item that dealt with an interesting problem in railroad car construction. The car that was described was so built that fresh milk could be transported over great distances. One of the tests that was mentioned was the carrying of milk from Wisconsin to Florida, a project that is surely worthy of note. However, one of our readers took exception to some of the statements in the article and we are glad to publish his letter in order that any mistaken impressions that may have been formed will be corrected.

Editor, Scientific American:

In the October issue of the Scientific American there was an article with a picture of an insulated refrigerator car for carrying milk from Marshfield, Wisconsin, to Miami, Florida. The heading of the article was "Shipping Milk 1,800 Miles to Market." The article went on to say that cows do not thrive in Florida and that fresh milk is 35 cents a quart, and that the supply is limited.

While we know that you cannot keep an absolute check on all such statements, the statement that cows do not thrive in Florida and that milk is 35 cents a quart cannot go unchallenged. I have seen Wisconsin, Michigan, Washington and New England cows but I have never seen finer looking or healthier cows than the ones in Palm Beach County. Milk is not 35 cents a quart in Florida. In fact it is 24 cents a quart. That is high enough without adding the extra 11 cents per quart.

Sincerely,
Lake Worth Chamber of Commerce,
Alvin E. Gillett, Secretary.

Relativity

Mr. James O. G. Gibbons, a consulting engineer, of 207 Market Street, Newark, New Jersey, sends us the following observations on relativity. Perhaps some of our Einstinian readers will be willing to discuss this matter with Mr. Gibbons.

Editor, Scientific American:

I have no doubt that many people who like myself have taken some interest in the Einstein theory of relativity have experienced considerable difficulty in understanding the statement that light always travels at a constant speed relative to an observer, irrespective of whether he is himself in motion or standing still relative to the source of the light.

The usual explanations may be quite satisfactory to those who are accustomed to deal with the more intricate mathematical conceptions, but to ordinary mortals like myself they are not very helpful.

In view of the above I have worked out the following, which seems to bring the case more within the realm of every-day experience and I should very much like to have your opinion or the opinion of your readers as to the validity of the argument.

Let A and B be two motor shafts—A being under control, both as to speed and direction, and B revolving at a constant speed of 2,000 revolutions per minute.

If we had instruments which would not indicate a speed of more than 1,000 revolutions per minute and ran shaft A at that speed, we should judge from the readings of our instruments that both shafts A and B were running at 1,000 revolutions per minute.

Assuming that there was no possible way in which we could indicate or observe a speed greater than 1,000 revolutions per minute we could never know that shaft B was really revolving at a speed of 2,000 revolutions per minute.

Now the speed which we are measuring is relative, in this case the speed of the shaft relative to the bearings of both shafts, or if shaft A be stopped we can say that our observation shows that shaft B is revolving 1,000 revolutions per minute relative to shaft A.

Let it be assumed that our instruments are of such a nature that they will indicate relative speeds not exceeding 1,000 revolutions per minute under all possible conditions.

We have already observed that shaft B is revolving 1,000 revolutions per minute relative to shaft A when it is at rest in its bearings. We will now cause shaft A to revolve at 1,000 revolutions per minute in the same direction as shaft B. Upon applying our instruments we shall be surprised to observe that they are indicating not only that shaft B is revolving at a speed of 1,000 revolutions per minute relative to the bearings but that it is still revolving at the same speed relative to shaft A, and if we should reverse the direction of rotation of shaft A, our instruments would still give the same indications as to the relative speeds of the two shafts.

In other words we should have to conclude that shaft B always revolves at 1,000 revolutions per minute relative to any other object, regardless of whether that object were itself revolving or not.

Of course in this case we immediately recognize that our observations are falsified by the limitations of our instruments. At the same time we must not overlook the fact that we can never observe anything but the appearance of things, and whether the appearance of things ever does or ever can, coincide with the reality of things we probably can never know.

In the case of light we are asked to believe that light travels at a speed of 186,300 miles per second relative to an observer irrespective of whether he is in motion or at rest relative to the source of the light, but how are we to know that light travels at this speed.

As a matter of fact we do not know anything of the sort, the only thing that we apparently do know is, that the physical universe is incapable of registering and presenting for our observation the appearance of any velocity greater than this.

If this is the case, should the real or potential velocity of light be more that twice the apparent velocity, it would be impossible, as in the case of our shafts, for the universe to present to our observation any velocity of light less that 186,300 miles per second, unless the observer were himself moving with a greater velocity than this towards the source of the light, which is impossible.

As we have already agreed that no greater apparent velocity is possible, we should therefore conclude that the velocity of light is constant (relatively) at 186,300 miles per second.

Thus we have a condition analogous to that of our motor shafts, and as before stated we can only deal with appearances and the reality must always be beyond our ken. Therefore one assumption as to the reality is just as valid as any other, provided that it checks up with the appearances. Apparently all we have to do in this case is to assume that light has a real or potential velocity of not less than 372,600 miles per second, but that the physical universe is incapable of presenting an appearance of, or responding to a greater relative velocity of 186,300 miles per second, which is in accordance with our observations.

Science from the Orient

One of our correspondents, Mr. E. R. Jacobs, writes as follows:

After combing the Sesquicentennial for a souvenir of a scientific nature, my wife and myself motored over to Atlantic City and found just what we were looking for in the "five and ten cent" store. This was a box of assorted shells, quite a little concological collection in itself, for only a dime. Turning over the box, the words "made in Japan" told the whole story. In far-away Japan where labor is cheap and shells are plentiful they make this pretty little seashore novelty from which much can be learned. I will now read Dr. Cockerell's article with new interest for we have the specimens without laboring for them, and a shell on a popular beach is a *rara avis*. It is only fair to say that collections of this kind can only be bought at seaside resorts and not in the ordinary "five and ten cent" stores of the city.

A New Telescope Society

The interest in amateur telescope making is mounting by leaps and bounds. So far, we have traced more than 1,500 who have taken up this engrossing work. The cooler weather of fall and winter, driving people indoors where they can work on their telescopes, is now giving this nation-wide—and, in fact, world-wide—movement a stronger impetus than before. Recently an amateur in Los Angeles requested the names and addresses of those in his community who had purchased "Amateur Telescope Making." We supplied them, and a club has been projected. In several cases we have received requests from isolated amateurs in other communities, for the addresses of neighboring telescope enthusiasts. At the risk of causing occasional annoyance we have given these names to bona fide "T. N's." Here is a letter from Los Angeles:

Editor, Scientific American:

For some time a number of amateur telescope makers have been planning to organize a society here in Los Angeles. Your "challenge" expedited matters somewhat, and the preliminary arrangements having been made, we are requesting you to do your "bit."

It would help us a great deal, since you are the only periodical common to all the 50 amateurs in Los Angeles, if you would give a little space in the Scientific American, telling of our meeting place and time.

Here is the data:

Meeting place: Study room above Science room in New Public Library.

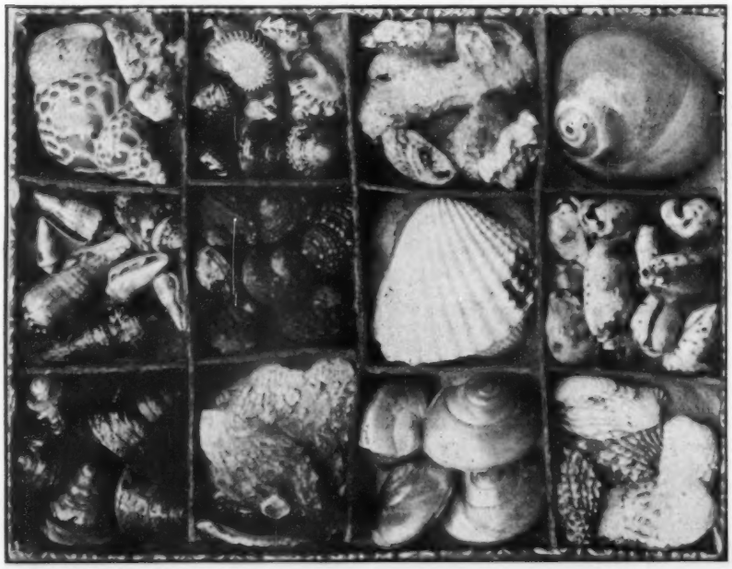
Time: First Thursday in every month, at 8 P.M., starting November 4, 1926.

Everyone is welcome, although we are making a special appeal to those interested in building their own telescopes.

After the telescopes still in the process of being built are finished, the society will doubtless promote useful work in astronomy.

If you will give this to the public through your columns, you will be doing a great favor to the amateur astronomers in Los Angeles.

Very sincerely yours,
Charlton F. Chute,
Los Angeles, California.



This interesting collection of shells cost one of our readers the small sum of ten cents. It is well worth the attention of the student of natural history

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Conducted by Milton Wright

Don'ts for Inventors

MANY inventors are afraid that someone is going to steal their ideas. They may be justified in this belief. Therefore, it is unwise for any inventor to make his plans public before he has applied for his patent. You may devote years to perfecting some method or device, and if you let it become generally known, someone else may adopt it. Whether that other man succeeds in getting a patent on it or whether he uses the method or device without a patent, it will make it harder for you to get patent rights and obtain the just reward to which your ability and industry are entitled. *Don't make a public disclosure of your invention until the application is filed in the Patent Office.*

There is such a thing, on the other hand, as carrying secrecy too far. It often happens that more than one person conceives the same idea at about the same time. Some time ago, for example, more than fifty different inventors applied for patents on the same invention—a stabilizer for airplanes—at about the same time. None could by any possibility have known of the activities of the others. It just happened that all these inventors hit upon the same thing. Priority of invention had to be proven. This could be done only by evidence of persons to whom the inventor had described his invention. *Don't fail, then, to tell two persons in confidence what your invention is and how it works. Put in writing the facts that you have told them and get them to sign and date the statement.* Then keep this statement in a safe place, so that if a question should arise at any time as to whether you are the first to conceive the idea, you will have the evidence to prove when you first disclosed it.

Why Patents Are Delayed

IN an oral statement on the changes effected in the Patent Office since his administration began five years ago, Commissioner Robertson said recently:

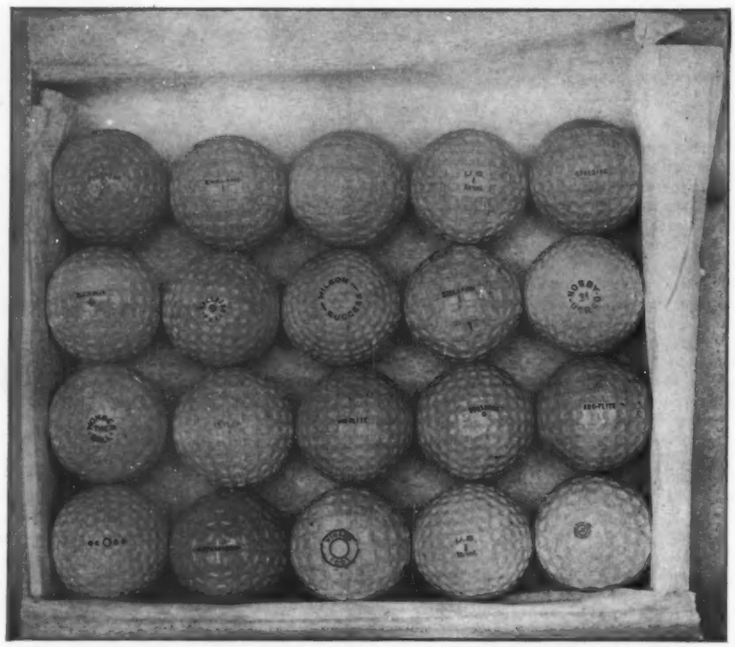
"Our chief delay in granting patents comes through the inadequacy of our examiners. We have 600 of them, and they are exceedingly skilled men. Most of them have college degrees. They must be qualified to examine applications for patents in every field imaginable, and to decide not only whether or not the application infringes upon some previously granted patent, but also whether or not the application is described in sufficient clearness to make it understandable.

"Our chief trouble is that after an examiner has become expert and valuable to us, we lose him to private industry. We lost 106 last year, and during the month of August we lost 16. Although Congress has recently increased the salaries of examiners, they are still taken away from us by the higher salaries of industry. Naturally, when our staff of examiners is depleted we cannot pass upon patent applications as quickly as we should."

Golf Ball Meshes

FIRST Assistant Patent Commissioner Kinnan denies the application of the Dunlop Tire and Rubber Corporation to register as a trademark a particular form of the meshed surface of a golf ball.

"It is well known and not disputed here," he says, "that the purpose of the meshed surface is mechanical, to cooperate with the roughened surface of the club, and, possibly, to aid in the reflection of light so the ball is more readily seen from a distance when it lies on the ground after having been driven by a player."



Golfers can identify the make of a ball by its markings. Can you? The real purpose of the mesh markings, however, are mechanical, the Assistant Patent Commissioner holds, but he fails to mention the most important function of all —that of making the ball fly true

After citing certain decisions, he concludes, "These decisions, and those recited in them, are persuasive that the meshed surface covering the entire ball and forming an integral part of the latter, and performing mechanical functions in the use of the ball cannot be regarded as a trademark for the goods. To hold otherwise would in effect be granting a perpetual patent for a golf ball having these features of construction."

The purpose of a trademark is to denote origin. On this theory the Fisk Rubber Company last year registered their "96" tread design of automobile tire as a trademark. The Patent Office held that it is by the tread design that the make of tire is registered. The practice, however, was overruled by the Court of Appeals of the District of Columbia when the Goodyear Tire and Rubber Company sought to register its tire-tread design.

Delays Are Dangerous

HOW a first inventor may be denied a patent in favor of a later inventor is illustrated in the recent decision by the Patent Commissioner in the case of Parks versus Hoffman. The invention relates to operating shafts for low-speed clutch bands of Ford automobiles and is designed to facilitate removal of the shaft when the clutch or transmission band is to be removed for repair.

In deciding for Hoffman the Commissioner says:

"Parks testified that the device was taken from the shop car and that it was never again used; that it was placed in a pigeon hole of the office desk until about the time he filed his application for the invention, admittedly being spurred on to do so by Hoffman's activities. Hoffman and the Hoffman Manufacturing Company gave the invention to the world several months before Parks filed his application. Parks' conduct, taken with the testimony, clearly shows that he never contemplated doing anything with the invention; that it was kept secret and it remained a secret to the whole world except the interested parties Parks, Bohne and Simpson, until after it was given to the public by another. These facts, it is believed, justify a holding of abandonment on the part of Parks."

A Real Pioneer Invention

JUDGE TUTTLE of the United States Court for the Eastern District of Michigan has written one of the clearest expositions of the distinction between mechanical skill and invention we have yet seen. It is in the recent decision establishing the right of George C. Walker and Thomas M. Lucking to collect damages for infringement from the Lakewood Engineering Company.

The Walker device, patent number 1,234,984, is used in finishing the surface of a road before the cement has set. Of its merit Judge Tuttle says:

"Nothing had been discovered that would do a better job than the trowel, until Walker produced the patented invention in suit, and brought in use the flexible belt or strap to be dragged across the surface of the road. It had never been used by any one so far as this record shows; no one had ever thought of such a thing or heard of such a thing as a flexible strap or belt, to drag back and forth in a reciprocating movement across the surface of the road as the very last step in the finishing of the road.

"Now this patent goes away beyond what can be called the work of a skilled mechanic. We have had a lot of skillful mechanics building roads, and we have had a lot of engineers—and skillful engineers—building roads, and we were fussing around with labor to do the last work by hand; and by hand I mean the trowel finishing of the surface, and using other things that did not leave the work in as good shape as this simple device of the patent in the suit. It is simple as one thinks of it; but that is just what defines an invention, in my judgment.

"It is not these great complex machines that necessarily disclose patentability and ingenuity. The draftsman familiar with the strength of material—and mechanics—can build very large machines and put a lot of mechanical elements and movements into them, making them expensive, but what we really intend by the patent law is to reward by the grant of a monopoly the bringing forth of something that can be used to our advantage which had not been thought of before. It makes the world a better place in which to live, as the result of what they have done. Here is a thing simple, not difficult to make, but nobody thought about it; they had not done it before."

Walker's device was intended to be used by hand. The defendant uses machinery to accomplish the same result. This, the Judge holds, does not avoid infringement.

"There is nothing," he says, "that the defendant's belt does that was not done by the hand-belt. Defendant's belt on the machine does not do so much, because it is not necessary to do so much, and, of course, not being necessary to do so much, it is not necessary to make it so heavy.

"They naturally change the tool to fit the work. That is the work of a skilled mechanic. No one has pointed out anything done by this belt of the defendants that was not done by the patent in suit. Defendants use this belt of the patent in suit and they get results from it or they would not use it, and those results are results accomplished by the patent in suit and this is infringement. Defendants do not need all the things that the plaintiffs' belt was designed to do, and would do, and they do not build it so that it would do all the things simply because they do not need all the things. That does not escape infringement. If a person has a patent to do certain things and accomplish certain results, and if I do not need to accomplish those results fully, but only partially, and I take their machine to accomplish a part of the results, I infringe."

How Valid Is a Patent?

"A PATENT is no good until it has been passed upon by the courts," is a statement sometimes loosely made. But just how true is it? Here is what the court has to say on the subject:

"The presumption that a patented combination is new and useful, and embodies invention has added force where, as here, it appears that the patents relied upon as showing anticipation were considered by expert patent office officials. While their judgment is not absolutely binding on a court, it is entitled to great weight and is to be overcome only by clear proof that they were mistaken and that the combination lacks patentable novelty."

With these words Judge Gilbert, writing the opinion for the Circuit Court of Appeals for the 9th Circuit, denies the appeal of A. J. Moehr and Son and the Standard Oil Company to set aside the lower court's decision sustaining the validity of the patent of the Hopkins air-brush for spraying paint, owned by the Alliance Securities Company.

The User Helps to Infringe

HOW the user of a manufactured article can help to make that article infringe a patent, is shown in the interesting decision obtained by D. Allen Lenk over Hunt-Lasher Company in the United States District Court in Massachusetts. The patent in question was for an automatic blow-torch with a heat-conducting wire in a jet-tube and a plug-wick in the flame cylinder, such as is used by jewelers, electricians and others for soldering and brazing.

"Defendant's jet-tube does not extend below the top of the blast cylinder and, as

originally sold by the manufacturer, no heat-conducting wire is inserted in the tube," says Judge Brewster. "But each torch sold is accompanied by printed instructions to users 'to insert two ordinary pipe cleaners in the tube' in place of the wireless wick, when that wick becomes charred. In these pipe cleaners is a metal center which, while not as efficacious as the copper wire used by the plaintiff, nevertheless embodies the same principle and when used clearly infringes claim six of the patent."

On these facts, the judge holds, the patentee is entitled to invoke two well established principles of patent law—the doctrine of equivalents and the doctrine of contributory infringement.

A Million-dollar Patent

"THE plaintiff has received nearly a million dollars in royalties from a dozen concerns, a tidy sum to receive for nothing." Thus Federal District Judge Bodine in New Jersey characterizes ironically the defense of lack of invention in the infringement suit of DeLaski and Thropp Circular Woven Tire Company versus Murray Rubber Company.

The Thropp patent, which contains 148 claims, provides for a machine for forming tire fabric down on the sides of the core and also forming it around and along the bottom of the bead. The latter operation had been performed by hand or by separate devices.

"Some question was raised upon the argument that the devices involved mere mechanical skill," says Judge Bodine. "A study of the inventions shows that more was involved. The stitcher mechanism with the angle-changing device may be a very small matter, but it changed the tire building business from machining and hand construction to machine construction. The defendant gives the tribute of its imitation to the invention.

"The whole tire is machine built, the underlying mechanism operates all parts of the machine and different elements operate upon the raw materials to produce the ultimate product. Thropp invented the machine, which is a true combination and not an aggregation. The plaintiff may have an accounting."

The Limits of Reissues

THE importance of drawing up the specifications and claims of a patent with the utmost care is illustrated in the infringement case brought by the Traitel Marble Company against U. T. Hungerford Brass and Copper Company. The patent was that issued to S. H. Calkins for improvements in pattern and guide strips. The defendants denied infringement, pointing out that the original Calkins patent had been reissued after having been declared invalid, and asserted that the reissue was invalid on the ground that a reissue does not and cannot confer validity.

"The reissue patent number 15,824 cannot broaden or add something that was not included in the original patent," Judge Goddard holds. "Section 4916—United States Revised Statutes which permits reissues, allows a patentee to limit the claims of the patent or to correct any defect or error which occurred from inadvertence, accident or mistake, but does not permit the injection of new subject matter into the patent. Therefore, if the original patent was invalid for the lack of the disclosure of invention, it follows that reissue patents would continue to be invalid."

Post-mark Advertising

THE British Government Economy Act passed by Parliament enables British commercial firms to advertise their goods by means of post-office cancellation stamps. Heretofore these stamps have been used exclusively for official slogans, such as "Visit Wembley" or "British Goods are Best." Now the post-office department has given a contract to a firm of London advertising contractors for the letting of this privilege. The contractors have received a schedule showing the number of stamping machines at every post office and the average number of letters a week passed through them, so that advertisers know precisely what advertising opportunities are available. Hereafter, therefore, you will know what it is all about should you receive a letter from London postmarked: "Good morning. Have you used Pears' soap?"

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

AIRCRAFT-FRAMEWORK MEMBER.—Formed of light metallic strips corrugated longitudinally to strengthen the same against crushing and expansion, the strip edges offering mating lap joints. Patent 1588327. D. J. Mooney, c/o Steel Wing Co., Nightingale Grove, Hither Green, London S.E. 13, England.

AIRPLANE CONSTRUCTION.—Having an extended lifting surface composed of a plurality of longitudinally disposed spaced wires adapted to support a plurality of sections of thin metal strips. Patent 1598118. T. Borgan, 111 Pioneer St., Brooklyn, N. Y.

AIRSHIP.—In which means is provided for maintaining the ship in a set course and for generally stabilizing the ship during its travel. Patent 1599496. W. Sheppard, 21 Bethune St., New York, N. Y.

Pertaining to Apparel

SPORTSMAN'S WADING STOCKING.—Whereby the heavy rubber boots may be dispensed with, and a specially constructed elastic rubber stocking, having considerable freedom, at necessary points used. Patent 1594086. C. F. Arnold, 230 California St., San Francisco, Calif.

COMBINED STOCKING AND OVERSHOE.—Which combines the utility of an overshoe and a stocking in one article of neat and attractive appearance. Patent 1596814. B. R. Dodge, 1701 Coney Island Ave., Brooklyn, N. Y.

BATHING SUIT.—Having the crotch of the trousers portion seamless, thereby increasing the wearing qualities, and comfort to the wearer. Patent 1597633. H. F. Stephens, c/o West Coast Knitting Mills, Box K, Huntington Park, Calif.

HOSE SUPPORTER.—Wherein the encircling band may be adjusted and is quickly engaged, but is locked when the parts are in operative position. Patent 1597188. M. F. Gaunt, P. O. Box 162, Dayton, Ohio.

BOSOM-SHIRT CONSTRUCTION.—In which the sides and lower edges of the bosom are free from the flexible body of the shirt, the bosom being secured only along a medial line. Patent 1600880. C. W. Hutchinson, 15 E. 40th St., New York, N. Y.

SHIRT OR SIMILAR ARTICLE.—Having a concealed adjusting means, including a series of fasteners, arranged to be effective in shortening the length of sleeves. Patent 1600897. M. Lesser, 576 Broadway, New York, N. Y.

SHIRT.—Which permits of its being used as an ordinary detachable collar shirt, but may be quickly converted into low neck, or sport shirt. Patent 1599968. S. Lipman, 843 South Los Angeles St., Los Angeles, Calif.

ARCH BRACE.—Adapted to be incorporated in the shank of a shoe, to preserve the flexibility of shoe, and strengthen the arch at the inner side. Patent 1601684. B. E. Drake, 54 Lenox Road, Rockville Center, L. I., N. Y.

Electrical Devices

RADIO TUNING DEVICE.—Including an outer primary coil, enclosing a secondary and tertiary coil, which triplex arrangement is placed over a standard bulb and socket. Patent 1598526. L. A. Jenny, 128 E. Madison Ave., Dumont, N. J.

PORTABLE LAMP.—Whereby means are provided for supporting the lamp without using nails, screws, or other securing devices, a combination vacuum and magnetic means being used. Patent 1598559. G. Cohen, 201 W. 49th St., New York, N. Y.

ELECTROMEDICAL APPARATUS.—For the production of low frequency currents for application to the human body, easily regulated to produce a variety of effects. Patent 1598862. K. P. Hangl, 1133 Tinton Ave., Bronx, N. Y.

SADIRON.—Which comprises electrically heated heavy roller, mounted to allow rolling over the work instead of sliding in the conventional way. Patent 1596181. L. M. Hills, 325 Georgia Ave., Santa Monica, Calif.

ELECTRIC TRIMMING AND SEAM-CUTTING MACHINE.—For cutting cork carpet, rubber flooring, battleship linoleum, and similar flooring material laid in sheet form. Patent 1598070. F. J. Faase, 634 Seybold Bldg., Miami, Fla.

ELECTRICALLY-CONTROLLED VALVE.—For automatically controlling the flow of gas to a burner for drying paper, during all the time that the presses are in operation. Patent 1600287. F. E. Lull, 2936 74th Ave., Elmwood Park, Chicago, Ill.

RADIORECEIVER.—Particularly adapted for installation in the conventional radio panel, allowing the electrode to be selectively engaged with and disengaged from the crystal. Patent 1599471. R. F. Kenyon, 46 Caine Ave., San Francisco, Calif.

Of Interest to Farmers

INCUBATOR.—Including a tray removably supported, having a plurality of rollers for supporting the eggs and motion transmitting means for the rollers. Patent 1598681. C. Y. Hake, c/o Green Hill Poultry Farm, R. F. D. No. 3, York, Pa.

SELF-DISCHARGING CULTIVATOR.—Which will operate between rows of corn or the like, scooping stones, weeds, etc., to the center space and automatically dumping them out of the way. Patent 1598960. L. A. De La Nux and A. P. Canova, 1325 So. King St., Honolulu, Territory of Hawaii.

DUST GUN.—A small manually operated device, with double action, thus insuring a constant supply of air pressure, for distributing an insecticide on growing crops. Patent 1600861. C. G. Allgrunn, c/o A. S. McDaniel, 434 W. 120th St., New York, N. Y.

Of General Interest

FOLDING TABLE.—Having novel and efficient means for holding the legs releasably either in folded or top supporting position. Patent 1593975. C. F. Karstens, c/o Fond du Lac Table Mfg. Co., Fond du Lac, Wis.

RUBBER-STOCK RACK.—Which will receive the hot rubber stock directly from the mill and will properly support the same without the use of soapstone. Patent 1597631. F. Spindel, Morrisville, Pa.

AMPLIFIER.—Constructed to accommodate any standard type of loud speaker unit, and will function to evenly distribute the sound in all directions. Patent 1597611. B. Mazanek, 400 E. 75th St., New York, N. Y.

SAFETY GAS COCK.—For use on the ordinary type of gas cocks, the cock being protected from accidental turning by spring pressed latches. Patent 1596913. J. G. Wilson, Ellendale, Del.

INKWELL.—Including a pen stand with ink well and enclosed fountain, for supplying said well with a relatively small quantity of ink. Patent 1596920. F. H. Casey, Box 172, Gardner, Mass.

ROADBED CONSTRUCTION.—By the arrangement of hexagonally formed slabs in such manner that a single slab will stand a maximum of pressure. Patent 1595686. L. A. Perry, Longview, Wash.

BUTTER DISPENSER.—In which the butter may remain in relatively large pieces, means being provided for severing a portion of predetermined size and weight. Patent 1597149. Irene G. Johnson and P. O. Berg, c/o Mrs. I. G. Johnson, 630 W. 141st St., New York, N. Y.

SANITARY COLLAPSIBLE INSECT TRAP.—In which the fly paper is entirely concealed and held in a flat plane, a number of openings providing access for the flies. Patent 1597,287. E. E. Pinkerton, c/o Pinkerton Folding Box Co., 414 Rush St., Chicago, Ill.

Switch Patents Upheld

THE District Court of Western New York, in the case of the Electrical Engineers Equipment Company against the Champion Switch Company, holds the disconnecting electrical-switch patents for high-voltage circuits, valid and infringed.

The object of Getts was to make a switch structure of the so-called disconnecting type, in which a maximum of contact was obtained between the fixed lugs and the switch blade or blades; while Jacobs designed, (1), an improvement in the spring pressure of the blades, and (2), a novel form of lock mechanism. The utility of the patented structure is shown by the fact that it has largely supplanted other high-voltage switches due to overcoming objections in the prior devices.

Judge Hazel holds:

"In view of the advance made in the art by both Getts and Jacobs, the claims for the broad invention do not require a narrow construction, and plaintiff is entitled to a fair range of equivalents. It is unnecessary to analyze the numerous claims of the Jacobs patent. Each contains a feature of novelty in relation to the invention, and all are found in defendant's structure.

"A decree may be entered with costs, holding the Getts patent and the Jacobs patent valid and the claims infringed by the structure of the defendant."

You Get Only What You Ask For

THE old saying that an inventor gets no more protection than he asks for in his patent claims is illustrated clearly in the recent decision of United States District Judge Tuttle in the Eastern Michigan District dismissing the suit for infringement brought by the Great Western Manufacturing Company against the Lowe Manufacturing Company. The patent in question was for a gyrating sifter. One of its features is portability. Judge Tuttle says:

"While I am convinced that a claim covering this idea could have been drawn and would have been novel, this idea is not expressed in the claims in suit, and cannot be read into them. It is possible that the inventor regarded his construction as entirely novel and, therefore, after preparing the broad claims in suit, he neglected to embody portability in any of his claims.

"Plaintiff's suggestion, that the court read into this claim certain limitations so as to save the claim from being anticipated, cannot be accepted.

"We must take this patent as it was prepared. Combs did not write such limitations into any of his claims and we do not know why he did not do so.

"If an inventor were permitted to obtain broad claims and thereafter write in such limitations as are necessary to avoid the prior art but still cover an alleged infringing structure, the public would never be certain as to the meaning of a claim and endless confusion and litigation would result."

Italy Falls Into Line

TECHNICAL men will welcome the news that Italy, following the example of the other leading countries of the world, has commenced the printing *in extenso* and in separate numbers of the specifications of patented inventions. All patents granted after October 1 of last year are said to come under the new regulation.

This leaves only Belgium, Spain and Portugal among the leading European countries still to take this important step in the right direction.

CLOTHES PROTECTOR FOR IRONING BOARDS. Attachable to the standard or support of an ironing board, forming a guard upon which overhanging pieces of clothing may be held. Patent 1596940. A. G. Norsworthy, 806 Palmetto St., Jacksonville, Fla.

BUILDING CONSTRUCTION.—By an arrangement of precast slabs which may be finished so as to constitute a complete part of the building when erected. Patent 1597167. J. D. Pace, Alexandria, La.

ACCOUNTING CALENDAR.—A monthly sheet for calendars, through the use of which accounts of such commodities as milk, bread and ice may be easily kept. Patent 1597280. E. G. Machauer, 2916 Palmer Ave., New Orleans, La.

CHAIR.—Capable of a number of uses, the construction being such that it is easily convertible into a step ladder or a high-chair. Patent 1596909. F. H. Weeks, 701 E. Market St., Akron, Ohio.

COMBINED DUSTPAN AND HOLDER FOR BROOMS, ETC.—Which may be readily manipulated for a desired purpose, or may be hung up for supporting brooms, brushes and the like. Patent 1598168. E. E. Stosser, c/o Y. M. C. A., E. 83rd St., New York, N. Y.

TRACK CURTAIN HOLDER. — Providing means for facilitating the suspension of a curtain or the like and for permitting the same to be readily moved. Patent 1598479. C. P. Day and A. Watts, c/o H. L. Judd Co., 87 Chambers St., New York, N. Y.

ORNAMENTAL CANDLE.—Of the wax body type, with means for preventing the candle from becoming deformed in the presence of abnormal heat. Patent 1598454. M. R. Sidwell, 423 Arch St., Camden, N. J.

BATHING CHAIR.—In which a bather may assume a comfortable seated position in the water, without danger of tipping over, and submerging the head. Patent 1598457. J. Sommer, 842 Rebecca Place, Elizabeth, N. J.

CARBOY.—Having at its sides and bottom resilient members to which are secured retainers carrying replaceable buffers. Patent 1598534. C. Lefkowitz, c/o Hercules Carboy Co., 350 South St., Newark, N. J.

HOT-PAN LIFTER AND REMOVER. — By which an operator may safely manipulate a hot pie pan without danger of being burned or spilling the contents of the pan. Patent 1598536. J. A. List, Carlyle, Ill.

DENTIPHONE.—For use with talking machines in order to reproduce the records in such a manner that deaf persons may enjoy the same. Patent 1598575. J. W. Gouce, Anderson, Tenn.

COMBINED TABLE AND BOOKREST.—Adapted particularly for use in a sick room, although not confined to such use, the device may be readily adjusted. Patent 1598569. C. G. Fitzhugh, The Maples, 713 19th St., N.W., Washington, D. C.

MOLD.—Especially adapted for use in the production of the packing rubbers employed on swabs and other well equipment. Patent 1597761. L. G. Burt, 325 E. 4th St., Tulsa, Okla.

REMINDER.—For household use, to indicate the condition of supplies of various commodities as they require replenishing. Patent 1598322. D. E. Showalter, Frankfort, Ky.

BRUSH OR MOP HOLDER.—Which is interchangeable, permitting of a different frame being readily attached, whereby the mops or brushes may be varied. Patent 1598549. H. Berlow, 156 E. 171st St. New York, N. Y.

PEN CLEANER.—Wherein means are provided for wiping an ink clot from the end of a pen, and also polishing the pen. Patent 1599318. J. A. Chrysander, 201 W. 109th St., New York, N. Y.

COOKING ACCESSORY.—Affording means for supporting solid food stuffs above the bottom of a cooking utensil, and precluding burning in the event of the liquid boiling away. Patent 1599321. E. S. Devlin, 1445 University Ave., New York, N. Y.

DISCHARGE TUBE AND CONNECTION.—Capable of use in conjunction with an outlet for conducting waste material, the device may be readily detached and re-attached. Patent 1599331. R. Karabán, 13 Lexington Ave., Brooklyn, N. Y.

FLOWER HOLDER.—For bowls and the like, wherein a plurality of rods are provided for holding the flower stems in a desired position. Patent 1599320. W. S. Daniels, 161 Davis Ave., White Plains, N. Y.

CONNECTING DEVICE. — For adjustably connecting together two ends of a flexible element such as a rope, clothesline or the like. Patent 1599342. H. J. Muhlfeld, 249 8th Ave., Astoria, L. I., N. Y.

TYPEWRITER DESK.—In which ample knee space and leg room is provided under the desk, when the typewriter supporting platform is lowered. Patent 1599351. F. S. Teetsel, 68 Dover St., Albany, N. Y.

BILL FOLD.—In which the clamping means provides convenience in inserting or releasing bills, and a transparent element is provided for an identification card. Patent 1599,292. E. Seavey, 359 Pearl St., New York, N. Y.

GARMENT HANGER.—Which is extensible or contractible, may be conveniently stowed in a suit case or even in the coat pocket. Patent 1598747. J. F. Scharles, c/o C. M. Walker, 627 Davidson Bldg., Sioux City, Iowa.

HUMAN EXERCISER AND STRENGTH TESTER.—Which may be utilized to exercise and develop the human body uniformly to a high degree, thereby upbuilding the general strength and health. Patent 1598940. S. S. Smith, Steelville, Ill.

ARTIFICIAL FISHING BAIT.—In which means is provided for instantly changing the general color of the bait, by substituting shells of different tints. Patent 1599763. D. Head, 1320 Birchwood Ave., Chicago, Ill.

UMBRELLA HANDLE.—Which is adjustable to constitute a straight handle for women, or an angular handle as generally preferred by men. Patent 1600046. S. J. Goldwin, 1195 E. 14th St., Brooklyn, N. Y.

DISPLAY STAND.—Which may not only be adjusted to different positions but may be used to support a number of different objects. Patent 1599616. S. Hamburger, 706 Ave C, Brooklyn, N. Y.

TREE REMOVER.—By means of which the roots may be cut, and the tree with its roots and part of the soil, lifted bodily for easy transportation. Patent 1599841. H. A. Sager, 1601 No. Van Buren St., Missoula, Mont.

ROLL.—Shaped especially to form a receptacle or space for a frankfurter, or other edible material in the form of a sandwich. Patent 1600191. E. Mandelbaum, 53 Hamilton Terrace, New York, N. Y.

STENCILING DEVICE.—Which includes a plurality of individual stencil elements and a frame for interchangeably assembling the same for use. Patent 1600177. A. Hurewitz, c/o Specialty Products Co., 545 Westchester Ave., New York, N. Y.

PORTABLE SACRAMENTAL AND DEVOTIONAL ALTAR.—Which may be readily erected in the home or hospital for private devotional purposes in administering the sacraments of baptism and communion. Patent 1600107. C. Gay, c/o Gay Bros., 142 Rowe St., New Haven, Conn.

BALLOON ADVERTISING METHOD AND APPARATUS.—By which circulars, novelties, etc., can be sent aloft over a public gathering, and at an opportune moment be scattered over the people. Patent 1598211. E. J. Maguire, c/o H. D. Schroeder & Co., 1616 Bush St., San Francisco, Calif.

Hardware and Tools

SOCKET WRENCH.—For tightening or loosening nuts of various sizes, such as those used on clamps for guy wires on telephone poles. Patent 1597785. F. J. Grant, 5922 Ada St., Chicago, Ill.

ELEVATING TOOL.—For lifting sucker rods, as used in well drilling, without the liability of disconnection or accidental release of the rod. Patent 1596343. L. Fielding, 110 "B" St., Oxnard, Calif.

ANIMAL TRAP.—Having an attachment for preventing the accumulation of matter under the swingable trigger, without interfering with its downward movement. Patent 1598780. B. McCabe, R. F. D. No. 6, Cresco, Iowa.

SAW.—In which the blade is adjustable at an angle to the handle frame, and may be readily locked in operative position. Patent 1598965. R. W. Graves, c/o Munn, Anderson & Munn, 24 W. 40th St., New York, N. Y.

FISHING TOOL.—Especially adapted for use in wells, having novel means for gripping a sucker rod at the shank, in cases where the box is broken off. Patent 1598,708. C. H. Brown, c/o Brown Welding & Machine Co., Breckenridge, Texas.

JEWELERS' TOOL.—A single tool in which rollers of varying sizes may be employed according to the requirements of a given piece of work. Patent 1600142. M. Rothenberg and I. Attias, 440 W. 45th St., New York, N. Y.

SURVEYING INSTRUMENT. — A binocular instrument of great precision and long range, no exposed or movable stadia hairs, the hairs being within the instrument. Patent 1598519. A. D. Hadsel, 500 Cale Bldg., San Francisco, Calif.

STOVEPIPE SUPPORT.—Adapted for supporting the angularly disposed runs of a stovepipe against sagging, or accidental displacement from one another. Patent 1598503. W. L. Plummer, 1131 "T" St., Sacramento, Calif.

BULL HOOK. — Having means therein adapted to automatically act to avoid danger of displacement of the engaged end of a choker line. Patent 1599727. S. B. Stewart, 220 So. King St., Centralia, Wash.

WINDOW FASTENER.—Which serves the double purpose of preventing rattling, and will permit of the sashes being slightly raised or lowered, and locked against further movement. Patent 1600850. J. A. Segalini, 500 Graham Ave., Long Island City, N. Y.

THREAD-PROTECTING DEVICE.—Easily slipped over the end of a pipe to protect the threads against damage by contact in the movement of the pipe. Patent 1600860. C. D. Young, c/o New London Ship Engine Co., Groton, Conn.

WRENCH.—Particularly easy to operate, and having a positive stop for the sliding member requiring an actual release before it can be adjusted. Patent 1599202. M. Brande, 146 Embarcadero, San Francisco, Calif.

STOVEPIPE SECTIONS.—Which has one end locked against expansion and the other end locked against contraction, the ends forming a threaded joint. Patent 1601640. J. V. Orr, Box 146, Monroe, Wash.

CARPENTERS' SCRIBING GAUGE.—Having an extensible body and protector heads for the scribing plates, for numerous uses, such as cutting stair treads, fittings shelves, etc. Patent 1601138. D. Moore, South Lancaster, Mass.

ADJUSTABLE T-SQUARE.—The head and blade being pivotally connected, a disc secured to one member and ring member to the other. Patent 1599776. Z. G. Lazarevich, 69 Joost Ave., San Francisco, Calif.

HAMMER FOR PERCUSSIVE DRILLS.—Arranged to permit tempering or hardening of the dolly head to any desired degree without injuring the tongues or riffles. Patent 1601644. W. S. Pekovich, c/o Admiralty Alaska Gold Mining Co., Juneau, Alaska.

BOLT FOR COMPOSITE FLOORS.—For forming a connection between the concrete and the sleepers for a wooden floor, and preventing surface irregularities. Patent 1599745. J. M. Cinnamond, 620 4th St., San Francisco, Cal.

COMBINATION LOCK.—Capable of a large number of combinations, and permitting of general use, particularly as a substitute for inexpensive key locks. Patent 1600338. J. A. Jones, 4233½ W. 28th St., Los Angeles, Calif.

KEY-ACTUATED ROPE LOCK.—Adapted to receive the two strands of a rope which close the opening of a mail bag, preventing movement in a direction to open the bag. Patent 1601046. R. L. Shannon, 501 Lyman Ave., Oak Park, Ill.

RAZOR ATTACHMENT.—Which is applicable to safety razors and will function to constitute a receptacle beneath the guard to catch the lather as it is removed. Patent 1600636. J. D. Kaltenback and J. Stoll, Hotel Cort, 34 Ellis St., San Francisco, Calif.

ADJUSTABLE SOCKET WRENCH.—Which is adjustable to be suited for a number of different sized nuts, and constructed for the handling of nuts in inaccessible places. Patent 1600645. J. C. Smith, Box 74, Milpitas, Calif.

Heating and Lighting

HOT WATER HEATING SYSTEM.—A combination tank heater and house heating boiler, so arranged that either may be cut off, and the heat generate into the other. Patent 1599323. A. H. Frank, Columbia, Pa.

RADIATOR.—Wherein the water is heated by an electrical heating element without altering existing radiators, thereby eliminating the cellar furnace boilers. Patent 1597014. A. B. Campbell and I. L. Brownwell, Orlando, Calif.

GAS BURNER.—For furnace or boiler structures, embodying a plurality of reversible and adjustable burner tubes whereby the heat generated may be effectively controlled. Patent 1600175. P. C. Hughes, 1516 E. 6th St., Tulsa, Okla.

STOVE.—Wherein the feeding of the fuel to the grate and the removal of ashes may be accomplished without the escape of dust. Patent 1600110. C. Griffin, 16 E. Cross St., Ypsilanti, Mich.

GASLIGHTING DEVICE. — Whereby whenever a gas cock is opened magnetic means are actuated to produce a spark for igniting the gas. Patent 1600857. S. J. Woods, 10 Burdick Ave., Newport, R. I.

OIL BURNER. — Which has automatic means for controlling the flow of fuel, both to the valve and combustion pot, and protecting the pilot flame. Patent 1601242. J. B. Ennis, 2400 Church St., Norfolk, Va.

INCINERATOR.—Adapted for holding refuse or waste material while being burned, the device is of durable construction, and the grate may be replaced. Patent 1601657. J. W. Thompson, 15 Terrace Ave., White Plains, N. Y.

Machines and Mechanical Devices

PLASTIC MOLDING MACHINE.—Having a plurality of stationary molds capable of being readily expanded for the quick removal of molded articles without possible adhesion. Patent 1593792. J. F. Caldwell, 212 Chamber of Commerce Bldg., Los Angeles, Calif.

WATER-WHEEL UNIT.—Embodying a plurality of wheels each having blades automatically feathered under the action of the moving water to fully utilize the power. Patent 1593804. F. L. McQuiston, 817 Garnet St., Redondo Beach, Calif.

WAVE MOTOR.—Utilizing a continuous flow of water, and automatically adjusting itself to the flow of a river, or the change of tides, for producing power. Patent 1594,826. L. G. Fairbank, 376 Ellis St., San Francisco, Calif.

HOIST.—A machine of the hand-operated type, having a maximum drum capacity, the desirable range in speed and power, and is readily controlled. Patent 1596477. R. H. Beebe, 3223 1st Ave., So., Seattle, Wash.

DETACHABLE COUPLING.—For pipe, hose and similar conduits, especially easy to manipulate, permitting of quick attachment or detachment in practically one movement. Patent 1596645. E. T. Whatley, 1119 Duffy St., East, Savannah, Ga.

FLEXIBLE COUPLING. — Embodying two coupling members utilized upon the adjacent ends of alined shafts, connected by movable elements, secured through circumferential openings. Patent 1596327. W. S. Weir and A. P. Foley, 627 Ivy St., Pittsburgh, Pa.

STOP MOTION FOR LOOMS.—So constructed that when any of the harness wires break, a proper connection will be made for causing the stop motion to function. Patent 1597,574. A. W. Boucher, 40 Luck St., Burlington, Vt.

CHAIN AND BUCKET EXCAVATOR.—Of the type employed in excavating land for the recovery of precious metals, the device having means for automatically scavengering the buckets. Patent 1595721. W. P. Hughes, 1157 Park Ave., Alameda, Calif.

PRESS-PAPER-ROLL CHUCK.—Which will operate automatically in holding the roll against rotation, so that it will not unravel or break during slack. Patent 1597568. R. W. Bandy, c/o Seattle Post Intelligence, Seattle, Wash.

STROBOSCOPIC APPARATUS.—For studying the movement of mechanism moving at relatively high speed, and having a specially arranged flashing means driven synchronously with the moving body. Patent 1597586. A. J. H. Elverson, c/o Andrews & Beaumont, 204 Bank Chambers, 29 Southampton Building, London, W. C. 2, England.

EXPANSIVE AND CONTRACTIVE DEEP-WELL DRILL.—Having simple means whereby the cutters are automatically moved to their operative positions, when reaching the limit of their downward movement. Patent 1597,143. O. M. Carter, 206 Scanlan Bldg., Houston, Texas.

SLICING MACHINE.—In which the meat or other material to be sliced is repeatedly presented to a revolving disk knife. Patent 1598562. W. J. Drucker, 909 Main St., Evanston, Ill.

ROLLER CUTTER.—Especially designed for use when rock or other hard substances are encountered, the drill being designed to sink the hole more rapidly. Patent 1597144. O. M. Carter, 206 Scanlan Bldg., Houston, Texas.

BABBITTING JIG.—Which is adjustable to properly support connecting rods, bronze backs and other forms of sectional bearings in proper position to be rebabbitted. Patent 1598540. H. A. Miller, 712 Mitchell St., Clovis, N. M.

MOSS-GATHERING DEVICE.—By means of which tree moss may be effectively and easily gripped and torn loose, may be manipulated from the ground. Patent 1598514. J. W. Benner, Route 1, Oxford, Fla.

HYDRAULIC LIFTING DEVICE.—For elevating sand and other granular material from a given place to a location at a higher elevation. Patent 1598558. E. Cohen, 224 W. A St., Picher, Okla.

FIRE FIGHTING APPARATUS. — Whereby the advance of flames or smoke in any given direction can be opposed efficiently by means of an air blast. Patent 1598568. C. B. Fields, 104 Linden Ave., Brooklyn, N. Y.

SKEINING AND ASSEMBLING MACHINE.—Which will form a skein from thread or yarn, will secure the ends of the thread together, apply a wrapper thereto, and discharge the finished skein. Patent 1598908. C. A. Hammond-Knowlton, c/o Belding Hemingway Co., 232 Madison Ave., New York, N. Y.

BOTTLE-CAPPING MACHINE.—For capping a form of non-refillable bottle, and subjecting the cap to pressure to conform to the beaded neck of the bottle. Patent 1599325. J. J. Garibaldi, 43 Macdougal St., New York, N. Y.

SHUTTLE SPINDLE.—Wherein the spindle functions to continually present an expanding and contracting member, whereby the cop of the core is gripped. Patent 1599291. J. Schumacher, c/o Schwarzenbach Huber Co., Union City, N. J.

COTTON PICKER.—Having rotating picking fingers imparting alternate fast and slow movements at each revolution, during their passage through the plants. Patent 1599,313. H. N. Berry, c/o H. A. Gamble, 212 Main St., Greenville, Miss.

CANDY VENDER.—Which is extremely simple, takes little space, presents the candy in an attractive manner in measured quantities, and in small bags. Patent 1596,980. G. H. Koster, 44 Glen Ave., Oakland, Calif.

DISHWASHING MACHINE.—Adapted to be set in a sink board, discharges its water into the sink, and is run by a motor. Patent 1596969. P. Hedstrom, 194 E. 31st St., Portland, Ore.

BELT-DRIVEN PACKER.—Having an attachment which will cause the tamper head to automatically descend when the press box is full of cotton. Patent 1599012. W. H. Holtby, c/o Holtby Packer Co., Chickasha, Okla.

MOLDING MACHINE.—Having means for automatically elevating the molded articles to free them from adhesion to the mold bottom and sides, for easy removal. Patent 1599873. J. F. Caldwell, 212 Chamber of Commerce Bldg., Los Angeles, Calif.

DISPENSING MACHINE.—In which the feed of the material from hopper to delivery device is very simple, and the cost of manufacture low. Patent 1600886. J. E. Kenkel, 308 Central Ave., Great Falls, Mont.

AUTOMATIC BAILER.—For boats, which is durable in use, may be readily taken apart and cleaned if it becomes clogged. Patent 1600849. A. H. Schweitzer, Valley St. and 5th Ave., Highlands, N. J.

MOLD HANDLING APPARATUS.—Entirely automatic in its completion of a cycle of operations, designed for use in conjunction with any type of brick molding machine. Patent reissue 16424. E. D. Cary, 434 W. 120th St., New York, N. Y.

AUTOMATIC DRINK MIXER.—With means for starting, regulating, and timing the agitator, and stopping the motor when the mixing has been completed. Patent 1600,543. J. A. Heard, 217 Delmar, San Antonio, Texas.

SIGNAL-OPERATING MECHANISM FOR GASOLINE TANKS.—Controlled by the level of the fluid for operating a signal when the level has fallen to a predetermined point. Patent 1600885. S. Kanter, c/o William Franz & Co., 129 Carondelet St., New Orleans, La.

PRINTING-PRESS ROLLER.—Made in sectional form, so that when the central section becomes worn, it may be readily replaced without discarding the entire roller. Patent 1600841. J. G. Neall, 90 Pleasant Ave., Pleasantville, N. Y.

BEAM-HEAD BRAKE FOR LOOMS.—Producing a uniform tensioning means which is comparatively simple, and by which wear on the beam-head rope is reduced to a minimum. Patent 1600928. J. Carroll, 61 Henderson St., Paterson, N. J.

AUTOMATIC TABULATOR.—For monotype composing machines, adapted to allow of effecting compositions divided in columns, by ensuring the automatic justification in each column. Patent 1600938. E. Garda, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

CONTAINER FOR VENDING MACHINES.—A metallic container to be used in lieu of glass, and readily adapted to different makes of machines, for vending peanuts, candy, etc. Patent 1601617. D. Greene, 1358 41st St., Brooklyn, N. Y.

GRAIN CIRCULATOR.—A simple and effective apparatus readily attachable to storage chambers of various characters whereby granular material may be circulated and aerated to prevent over-heating. Patent 1601224. J. F. Reavis, Baguio Benquet, Mountain Prov., Philippine Islands.

Medical and Surgical Devices

HYPODERMIC DEVICE.—Particularly adapted for obtaining perfect sanitary conditions, a single use of the device making a second use impossible. Patent 1594595. E. Brauer, 9 Wegman Parkway, Jersey City, N. J.

COLONIC IRRIGATING DEVICE.—Which will afford the maximum dimension of outlet without presenting barriers to the flow of fluid, readily introduced into operative position. Patent 1596847. J. S. Mallory, c/o General Delivery, Asheville, N. C.

ADJUSTABLE - PLANE ARTICULATOR. — Adapted for dentists, by which the actual centers or axes of rotation can be readily ascertained and fixed for each individual head. Patent 1598535. J. A. Lentz, 44 No. First St., Phoenix, Arizona.

Musical Devices

PIANO ACTION.—Which aims to insure greater rhythmic precision, a quick repetition of the hammer strokes, and a reduction in number of parts. Patent 1598203. B. F. Laukandt, 1234 W. 6th St., Red Wing, Minn.

PIPE-ORGAN CONTROL. — Which consists largely of relay and chest actions which cooperate in such a manner as to practically constitute one part. Patent 1599178. G. H. Kloehs, 121 No. 18th St., Philadelphia, Pa.

PIANO ACTION.—For upright pianos, designed to take up little room, thereby obviating the necessity of extending the piano casing to accommodate mechanical players. Patent 1599743. J. W. Carnes, 101 W. Central St., Kewanee, Ill.

Prime Movers and Their Accessories

SPARK-GAP APPARATUS.—Adjusted to permit the passage of the first discharge, but too wide to be bridged by the return and subsequent pulsations from any single discharge. Patent 1594457. P. Davey, c/o Andrews & Beaumont, 204 Bank Chambers, 29 Southampton Bldg., London, W. C. 2, England.

AIR CIRCULATOR FOR INTERNAL-COMBUSTION ENGINES.—For venting and circulating the air in a transmission case, permitting the escape of hot air and the entrance of cool air. Patent 1595020. O. H. Nadler, 1205 N. 13th St., St. Joseph, Mo.

CHARGE HYDRATOR.—Which will be automatic in its action to feed aqueous moisture to the charge, and will provide for complete control of operation. Patent 1595704. S. B. Caldwell, 7030 Lacy Way, Oakland, Calif.

INTERNAL-COMBUSTION MOTOR. — Making use of a single rotary intake valve, and a rotary exhaust valve for all the cylinders, a novel gear mechanism operating the valves. Patent 1596069. F. C. Skiles, 653 N. Central Ave., Chicago, Ill.

STEAM GENERATOR.—In which the heat both in downward and upward flow is utilized, the rising heat being used to assist in vaporizing incoming raw fuel. Patent 1596,797. C. T. Briar, 1211 Arnold Place, San Diego, Calif.

CRANK-PIN LUBRICATOR.—For lubricating bearings in instances where devices, such as dippers, do not form part of the general equipment of the motor. Patent 1595131. B. H. Wilder, Orleans, Calif.

CARBURETOR.—Having a primary and secondary air supply and fuel supply controlled by the same suction-operated mechanism, and a manual control. Patent 1600294. M. R. Nice, 5000 Cottage St., Frankford, Pa.

PACKING FOR ROTARY-ENGINE PISTONS.—For effectively preventing the passage of steam past the moving part of a piston, thereby preventing loss of power. Patent 1601397. S. E. Kochendarfer, 913 "L" St., N. W., Washington, D. C.

Railways and Their Accessories

RAILROAD CROSSING SIGNAL AND PROCESS OF OPERATING THE SAME.—Which is illuminated by the headlight of an approaching locomotive, whereby a person approaching the crossing will know that a train is approaching. Patent 1594443. K. M. Bard, Manawa, Wis.

PULLMAN-BERTH GUARD.—Adapted to extend across the front of a berth to prevent persons in the aisle being thrown into the berth by a sudden lurch. Patent 1596099. L. Hartwell, 3139 Indiana Ave., Chicago, Ill.

AUTOMATIC RAILWAY GATE.—Actuated by a passing train, not only operating the safety crossing gate, but a series of visual signals connected therewith. Patent 1596344. W. H. Finney, 918 Grove Ave., Nashville, Tenn.

FREIGHT-CAR DOOR. — With automatic means for securing the same in either open or closed position, equally adaptable for single or double doors. Patent 1597079. E. W. G. Kugley, Box 583, Charleston, S. C.

WRIST-PIN FOR LOCOMOTIVE CROSSHEADS.—Which may be driven in place from the outside, and removed with facility, the loosening while in operation being a remote possibility. Patent 1599740. H. G. Becker, Colonie P. O., Watervliet, N. Y.

AIR CONTROL FOR LOCOMOTIVE FIRE BOXES.—Causing a higher degree of superheat and less back pressure, and protecting the fireman from the excessive heat of the fire box. Patent 1600280. J. N. Glover, c/o Roberston, Higgins & Boddington, 428 Brotherhood Bldg., Kansas City, Kansas.

Pertaining to Recreation

TOBOGGAN SLIDE.—For directing a toboggan, formed of a plurality of boards so secured that they will be practically equivalent to a single board. Patent 1594444. J. W. Bernardy, Beardsley, Minn.

AMUSEMENT DEVICE.—Having a rotary carrier with seats for passengers, the carrier being propelled either by the passengers or any other driving means. Patent 1599014. O. B. Hunter, 1126 So. 6th St., Chickasha, Okla.

Pertaining to Vehicles

VEHICLE.—The inventor has been granted two patents on spring suspension for road and rail bogie vehicles, requiring no alteration of compression of main springs on tilt of bogie, and permitting steering with but little effort. Patents 1495448 and 1517193. Montague Churchill-Shann, 548 Hanel St., Albury, Australia.

LUGGAGE CARRIER AND TOURIST TABLE.—Adapted to be connected to the running board of an automobile, may be employed as a table by day, or a bed at night. Patent 1597081. C. R. Lyon, 1317 A St., Butte, Mont.

MULTIPLE-VALVE GRINDER.—By means of which the entire set of valves of a motor may be simultaneously ground in one operation. Patent 1597601. J. J. Kilbride, Mountain and Montague Aves., Scotch Plains, N. J.

GEAR SHIFTER.—Almost solely actuated by the exhaust gas of the motor, a brief use of electricity and the pressure of a push button and the clutch pedal. Patent 1597253. W. G. Stevens, Jr., 100 W. 55th St., New York, N. Y.

TIRE CARRIER AND CHANGER.—Which functions either as a carrier for a spare tire, or as a tire-changing means to be emplaced on a table or support. Patent 1599327. J. L. Greenwood, North East Harbor, Nova Scotia, Canada.

TRAILER HITCH.—Which affords facilities for connecting a trailer with the frame of an automobile truck, so that the pole can swing without transmitting motion to the vehicle. Patent 1599834. W. C. Nabors, c/o Nabors Garage, Mansfield, La.

DETECTING DEVICE.—For detecting an automobile driver who hits a person with his car, and drives on, the device is intended to be under police control. Patent 1598565. B. R. Edwards, 2439 Grove St., Berkeley, Calif.

VEHICLE STOP MECHANISM.—A mechanism operable to block the road wheels of a vehicle, and prevent translatory movement of the running gear in one direction. Patent 1600111. W. A. Haegele, 662 Court St., Elizabeth, N. J.

DEFLECTOR FOR HEADLIGHTS.—That will brilliantly illuminate the roadway from a point far in advance, but will prevent glare. Patent 1600271. A. J. Bishop, Box 441, Lincoln, Me.

AUTOMOBILE AWNING.—Which is inconspicuous when not in use, but can be instantly lowered to serve as a sun shield, or to prevent rain entering a window. Patent 1600270. J. W. Bermes, 32 Main St., Park Ridge, Ill.

SIGNAL DEVICE FOR MOTOR VEHICLES.—Especially adapted for trucks or busses, to be swung into operative position and become automatically illuminated to indicate the direction of turn. Patent 1600273. J. E. Glancy, 481 W. 25th St., Chicago, Ill.

CORNER GLARESHIELD.—Which will simultaneously shield both the front and side vision of a driver, against the glare of the setting or rising sun. Patent 1599183. G. E. Phillips, Box 474, Imola, Calif.

FIRE-TUBE BOILER.—For use in connection with motor vehicles, increasing the power, because of the resistance to condensation by the high temperature within the cylinder. Patent 1599169. P. C. Dykes, c/o B. W. Luke, Mercantile Trust Co., Front and Clay Sts., San Francisco, Calif.

PEDAL WITH DOUBLE-PIVOT JOINT.—For vehicle brakes, so disposed that the reduction ratio will be small during the period corresponding to the taking up of the wear. Patent 1601649. C. Schaeffer, c/o C. Bletry, 2 Boulevard de Strasbourg, Paris, France.

CHILD'S VEHICLE.—Comprising a frame, front and rear wheels, gear trains, and pedals adapted to be propelled by the feet of a child. Patent 1600646. J. Stetson, c/o Nelson Steamship Co., Pier 24, San Francisco, Calif.

ENGINE-HOOD-LOCKING DEVICE.—For automobiles, wherein the hood will be normally locked but may be manually unlocked when the engine is running. Patent 1598572. J. P. Geraghty, 481 Grove St., Jersey City, N. J.

SHORT-CIRCUITING DEVICE.—Adapted for electric motors, for short circuiting the commutator of the motor in order to prevent overloading the same. Patent 1600124. S. E. Miller, 2229 Hobbes Ave., Springfield, Ohio.

Designs

DESIGN FOR CURTAIN POLE BRACKETS, POLE-ENDS, AND POLE-CENTER ORNAMENTS.—H. L. Judd & Co., 87 Chambers St., New York City, have been granted twenty-one patents relating to curtain pole brackets, curtain pole ends, center ornaments for curtain poles and the like, having characteristic designs produced by their designers A. Dlouhy and W. F. Hofman. The patent numbers are 70,733, 34, 35, 36, 37, 38, 39; 70740, 41, 42, 43, 44, 45, 46, 47, 48; 70755, 56, 57, 58, 59.

DESIGN FOR A WATCH BAND OR SIMILAR ARTICLE.—Patent 70872. H. Bertolone, 17-19 W. 45th St., New York, N. Y.

DESIGN FOR A CHILD'S DRESS.—Patent 70827. T. Davis, c/o Franklin Simon Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A RING.—Patent 70982. R. Rosenthal, 609 Montgomery St., Brooklyn, N. Y.

DESIGN FOR A DOLL.—Patent 71095. O. B. Winters, c/o Bater Carteson, Erwin Wasey & Co., 250 Park Ave., New York, N. Y.

DESIGN FOR A LAMP PEDESTAL OR SIMILAR ARTICLE.—Patent 71107. L. H. Gorowitz, 1305 Prospect Ave., Bronx, N. Y.

DESIGN FOR A VANITY CASE.—Patent 71147. M. Kline, c/o Superior Products Corp., 3 W. 29th St., New York, N. Y.

DESIGN FOR A SHOE.—The inventor has been granted two patents 71135 and 71136. T. Davis, c/o Franklin Simon Co., 38th St. and 5th Ave., New York, N. Y.

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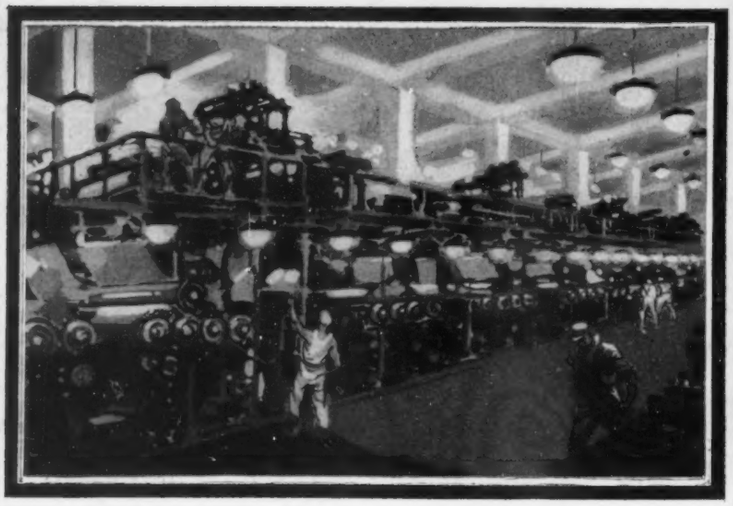

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